

THE GEORGE BLUMER EDITION OF

BILLINGS FORCHHEIMER S
THERAPEUSIS OF INTERNAL DISEASES

VOLUME V



THE GEORGE BLUMER EDITION OF BILLINGS-FORCHHEIMER'S THERAPEUSIS OF INTERNAL DISEASES

CARE AND MANAGEMENT OF MALADIES AND AILMENTS OTHER THAN SURGICAL



VOLUME V

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DISEASES DUE TO TROPICAL CESTODES

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#### CHAPTEP I

#### DISEASES OF THE NOSE AND ACCESSORY SINUSES

BURT R SHURLY AND GEOPGE E SHAMBAUGH

# RELATION OF GENERAL THERAPEUTICS TO SPECIAL TREAT MENT OF THE UPPER RESPIRATORY TRACT

The natural modern trend of our highly developed specialties is rap idly producing a sharp line of demarcation between the treatment of gen eral and special pathologic phenomena. There is danger in this development that rhinology and larvingology may become departments of therapy only, while the state of the general human machine is frequently ignored Many disastrons failures of treatment by laryngologists are examples of this fact. Many conditions of the upper re piratory tract are wholly systemic in origin and must be treated on a broad and liberal basis example, this department of medicine must be ever alert to offer there peutic care to the various special and frequently general manifestations that occur in apphilis, tuberculosis, diplitheria diseases of the ductless plands, gout rhenmatism, and various general infections of the staphyl ococcus, streptococcus influenza bicilli and other pathogenic bacteria Therapentics has developed a series of specifics and other remedies of great value. Their usefulness is placed upon a definite and exact basis of value These therapeutic indications must be met as promptly by the specialist as by the internist Textbooks are liden with innumerable drugs and general therapeutic measures that are recognized by practi tioners as worthless and hurmful from the fact that frequently valuable time is lost in the treatment of disease by therapeutic methods that deserve a place only in the history of medicine. It has been our endeavor to eliminate and discard remedies that serve to fill the pages of the text book and mention those only which clinical experience has proved of real curative merit, or at least as additions to the comfort and not the dis comfort of the patient. There is a place in laryngology for the physician as well as the surgeon Recently the radical argeon larvagelogist is ree ding to the more logical fields of conservatism, and slowly he will appreciate more and more the true usefulue s of his friend and consultant the phy ician larvagologist



Against an acute attack, radical abortive measures must be adopted early. The time-honored administration at bedding of 5 to 10 gr (0 3 to 0 6 gm) of Dover's powder alone, or with 5 gr (0 3 gm) each of aspirin and quinn is frequently successful. A ministral foot built mill encourage lenk-ocytoms and a hot lemonade with spiritus timent will establish diaphoresis. The pritent should immediately retire and remain covered with several warned blankets until profus, prespirition ensues. On rising in the morning, a shaline lyrative such as a "xiditic powder or "Sol Rochello [3s miy bo necessity. During, the day the Lincoln formula of quinn sulphate, gr ½ (0 03 gm) fluid ext the bladonna, gr ½ (0 007 gm), guin cumphor gr ½ (0 012 gm), every two or three hours, or 3 drops each of tr belladonna and tr opium in a hiff once (15 ec.) of emphor water may be given.

The no e should be expansed under good illumination and a culture taken from the ceretion if the vacene treatment is to be adopted or a stock vacene may be cale on If Bosvorth's method be selected—then a 20 per cent solution of cocum is applied to the inferior turbinates after which a bed of chromic nead is fined upon a probe and with this a fine linear cauterization is made along the median surface of each inferior turbinate.

Trouble may be seconded by inquiring for any diosynerssy against quantum or beliadount before continuous does of these remedies are presented. If the abortive treatment is not successful much may be done for the comfort of the patient by the use of spriys irri_pations, and pi_p musts. The various preparations of the suprareanal gland are useful Adrenalin chlorid diluted with normal salt olution (1 10 000) with or without cocain or encum (1 per cent to 3 per cent) affords relief. The nose may be irri_pited with a mild solution of Pulv Antisepticus Co USP

The antenor douche must be used with cention. The patient's head is tipped well to the left and he is requested to take and hold a long breath while the right nostril is slowly irrigated with the mouth open. The head is then tipped to the right and left nostril irrigated in the same manner. Viscul tenueous ceretion is disologed by this method to the great relief of the sufferer. This procedure is free from danger if performed with gentleness and correct technic in properly selected cases. A spriy or application should follow of

Pulv mentholis
I ulv camphoræ
Petrolati liquidi

31 (3 ° 0 mm)

A good office application that will reduce and hold the annoving in tume-scence is cocain 2½ per cent, antipyrin 2½ per cent. If suprarenal

#### RHINITIS

Acute Rhmits (!cute Corp.a) —The treatment of neute rhinitis in voltes primarily a study of the habits dress, occupation, temperament, local and general physical defects and immunity of the individual. This study will develop primarples of prophylaxis that require enforcement by caveful attention to detruls.

Neglect or circlessness in regard to clothing house ventilation or heat ing and exposure must be studied and the remedy suggested. A definite plan of cold sponge bithing or sleeping outdoors may be of prophylectic benefit. The neck and chest may be quickly sponged with cool and later very cold water, or the body may be gone over with a stiff flesh brush. When this latter procedure is adopted the smallest amount of water which will form a lather with pure white eastle or common launders scap should be used. A sharp reaction of the skin should be obtained afterward by brisk friction with a Turkish towel, which will remove the lather without rinsum. This morning both should be taken in a room which is thoroughly warmed. In debilitated subjects the change to a cold bath should be made gradually.

Many individuals are pitticularly susceptible to drafts of air, and some to drafts when applied to definite areas of the body, such as the back of the neck, the intersequalar region, or about the fect. Advice in regard to wearing appired may be advintageously given. The use of high shors, warm stockings, and proper underweir of wood, silk, or flannel will prove a necessary prophlylaxis in some cases. Chest protectors, neck turs, and muffiers should be dispensed with. Many colds may be prevented by the prompt armonal of damp clothing, especially shoes, so that body heat is quickly restored.

In cases of recurrent cory za the condition of the nasal and nasopharya geal chambers must be thoroughly investigated. Septial deformation, livertropines adenoids, polyps, derone sams infection and all other important conditions that interfere with nasal drainage and respiration must receive proper surgical attention. When acute coryza is present in the household delicate subjects may receive a prophylactic inoculation of a vaccine. This may be prepared from a nasal culture obtained from the member of the family who was the original source of infection.

A careful result on of the temperature of hving rooms to about 65° F is important, while a cold, well ventilated elepting room, warm bed covering, and right garments are advintageous to many people during the winter months. Susceptible infants and young children may be provided with an improvised elepting bog or blank its may be printed to avoid the dangers of exposure at might. Sleeping out of doors or in a window tent has given excellent prophylactic results in as lected cases.

RHINITIS 7

mild pathologic changes have occurred medicanal methods may be sufficient. Cleansing sprays or douches of Dobell's or Seiler's or of the normal salt solutions, or a solution of potassium permanganate, gr. ½ to 5, or a solution of Pulv Antiseptic Comp. ½, teaspoonful to the pint will be sufficient. Many escharotics have been advocated. Those of rivil powerlowever, are chromic and monochloricetic or trichloracetic and. In the intunescent varieties these measures, especially with children, afford prompt rehef—in properly selected cases. The fused bend of chromic and is preferable to many plans but the danger of excessive cauterization is imminent if the and runs on the floor of the nose or extends over an uncontrollable area. The trisue should be dired before the acid is applied Mild intunescent and hyperplastic conditions may be improved by applications every third day of argyrol, 20 to 50 per cent, or mitrate of silver, 5 to 10 per cent, or rotin grams v, to glycerin 5ss aqua 3ss

Many favorable results are reported from electrolysis Five to 10 m a are passed through a double needle by the bipolar method for three to five minutes The galvanocautery affords the best and most definite method (except those strictly surgical) of reducing intumescence and hyperplasia Free nasal drainage and respiration may be quickly and simply restored in moderately severe and otherwise suitable subjects by this procedure. The inferior turbinates should be cocainized with a 2 to 4 per cent solution, or alypin 10 per cent before operation deep line should be drawn from the posterior portion of the turbinate body anteriorly, and extending down to the periosteal layer. The wound should be covered with a bland oily spray followed by an mauffiction of aristol The middle turbinate should not be cauterized. When these measures appear to be ineffective (or, in fact in all cases of marked nasal obstruction) prompt surpical methods should be adopted submucous resection or anterior and posterior turbinectomy of the inferior and middle bodies are operations which when indicated afford splendid results

Membranous Rhintis—The plan of therapy adopted in peudomembrinous rhintis is dependent in part upon the bacteriologic findings. The presence of klebs-Loeffler bacilit particularly with a secondary in fection elsewhere demands an early dose of anticiphilheritie serium, the initial strength of which should be 5,000 anits. In mild primary infections among adults under continuous observation antitoxin may be held in reserve. As the involvement of the nasal amouns membrane may be reassumed in like form to tuose under immediate exposure, the prophylactic use of antitoxin may be nece sary. The usual dose of caloned, followed by in appropriate saline, such as Rochelle salts will be indicated Locilly a thorough cleansing treatment should be prescribed. For this purpose the posterior or carefully directed anterior, douche of warm nor mal salt solution horic acid, soda bierabonate, or liquic calles U.S.P., extract or adrenalin is used care must be exercised not to introduce these solutions without considerable dilution. Harm is often done by the use of astrongent and irritating sprays

In the subading stage a capsule of cinchondin sulphate, gr 2 (0.12 gm) and hydrastin (white alkaloud), gr 1/4 (0.015 gm) is efficienced in children the tineture of chlorid of rom with glycerin and water is valuable. It subacute intunescence prevails the application of the galvanocautery affords relief during the winter season. In infants or young children relief may be secured by the instillation of a solution of ordered in (1.10,000), followed by argyrol or silvol 20 per cent—put 5 to 10 drops into the nostril with a medicine dropper. Inhalations of 1 part menthol to 10 to 20 parts of chloroform may be used on a hand kerchief, or with a convenient nose and mouth inhale.

As acute rhinitis is usually caused by microbic infection, an investigation of the hacterology will reveal most frequently which are the inner organisms concerned catarrbahs, staphylococcus, streptococcus, pneu mococcus or influenza bacillus Great curative value is claimed for the autogenous vaccine made from the culture. When the laboratory equipment is not available a stock vaccine with urotropin internally may be given. The true worth of this treatment must be demonstrated by future clinical reports.

Chronic Rhinitis - Anatomic or pathologic conditions that are suf ficient to interfere with nasil drainage or proper respiration must receive surgical attention The etiology should be carefully investigated. and systemic dyscrasie such as gout, rheumatism, tuberculosis, syphilis, or focal infection cardine and renal insufficiency, must be given appro priate treatment. The cree-sive use of alcohol tobacco, or drugs will prevent successful treatment, and they mu t be discontinued or modified Habits of personal hygiene should be considered, and details relating to proper clothing exercise, bathing, and ventilation of the working and sleeping apartments should be subjects for instruction to each individual sufferer The warm and dry chmates of Egypt, Mexico, Arizona, New Mexico, and the Northwest are often advisable when the leisure, the financial condition, and inclination of patients will permit travel and absence from home Among children with a tendency to overactivity of the lymphatic system the syrup of the todid of tron or the syrup of hydriodic acid would be an important aid to local treatment. The early removal of adenoids of the nasopharyna, and offending tonsils, offers a valuable prophylactic measure in limiting acute inflammations in the upper respiratory tract, and all of the chronic rhinitis of adult life
Every case of chronic rhinitis presents two chief therapeutic indica

Every case of chronic rhinitis presents two chief therapeutic indications the establishment of thoron, b cleanliness by the restoration of free nasal drunage and free nasal respiration. The e-must be recomplished by the destruction of the least possible amount of mucous membrane. If RHINITIS

the exercise of patience and persistence. Especially with children it is necessary to use alkaline solutions that are pleasant in taste and odor for cleansing purpo es Of the official preparations the solutions made from Sciler's tablets, sodium chlorid borax, or boric acid are convenient, cheap and efficient Innumerable preparations have been marketed that contain these essential ingredients whose color and odor are made attractive. The efficiency and value of them, however depend upon their alkalinity and mild antiseptic properties. In severe cases where the crusts are dry and tenacious and show marked decomposition, potassium permanganate, 1/12 gr to the ounce, peroxid of hydrogen or sol mercuric chlorid (diluted 1 7) 1 3 000, may prove of greater usefulness than the above-mentioned preparations. These solutions should be warmed and either sprayed or syringed through the meal passages both anteriorly and posteriorly J C Test reports pronounced results from the use of water soluble scarlet red (Biebrich ozo-benzin) After an alkiline douche or spray a 4 per cent scarlet red emulsion is applied to all parts of the nasal miscous membrano with gentle massage The application is renewed every forty eight hours although the odor and crusts may be absent after the second application

If these measures are insufficient to remove crists and infected secretions from the naval channels cotton swabs saturated with peroval of hydro,cn should be used. Treatment often fulls because thorough cluming methods have not been adopted. The naval pussages should be carefully examined after the douche or sprars are made in order to determine satisfactorily the condition of the nasal cavities before a routine

treatment is instituted

Of the various oleannous preparations for applications or sprays that have been recommended in great number olcum piers and balsam of Peru may be considered among the best and satest. Thymol menthol and camplior may be used from time to time as adjuvants and as convenient preparations for home treatment however G L Richards favors a denche containing 5 to 10 drops of formaldchad in 8 ounces of warm water, preceded by an application of eocum. In the more advanced stages of atrophy the milder methods are inefficient and additional stimulating treatment mu t be chosen. No cases that afflict these unfortunates call for greater mutual courage and persistence on the part of the patient and physician than the chronic atrophic forms that have developed ozena with all its depressing conditions Galvanism and firadism applied over a period of months may give well-carned results. The current should be pa sed through a naked electrode with a hall-shaped distal extremity The electrode should be long and slender and all atrophic regions should be reached if po sible. The treatment is commenced with 1 to 5 ma and gradually increased at each succes too sitting. The cathode is placed against the unricular fosse while the mode is pred ripidly over the atrophic areas. Later the faridic may be substituted will lessen the absorption and aid the exfolition of pseudomembrine Perovid of hydrogen may be applied directly to the parts with a cotton pledget. It inhibits the broterial growth. It must be remembered that the separation of the p endomembrine from the naval nuccess levies a raw and frequently bleeding surface, therefore, it should be neither forcibly detached nor treated with powerful authorities or astringents. The excoration may be treated with advintage by applications of silver untrue [10 to 20 gr. (6 gm.) to the ounce (30 cc.)] or a copper sulphite solution. Aristol insufflated freely is particularly beneficial. When the acute symptoms have subsided tome tratment such as the claim of calisary a non and strychini should be administered. Iron and strychini may be given in duly by podermic doses, 0s iron citrate, 001 strychini sulphite.

Atrophic Rhinitis—A glance at the various textbooks rereals the fact that the number of remedies advocated for the treatment of "atrophic rhinitis" is quite as great as the inefficiency and uselessness of the majority of them. A definite plan must be selected and centinued for some months if good results are to be expected. The treatment should be general and local. Attention must be given to largenie details, and all exposure avoided when possible. An even, warm, moist climate favors recovery, and many patients improve rapidly in a subtropical climate. The use of the tolids of iron, atsente, or potassium is indicated, and thoir tonic and alterative action on the glandilar apparatus is benefical. His podermic in jectious of the citate of iron and strychini are very effectual in memociases. The hemoglobin may be raised 5 per cent a month by this method. A comparatuely punitess hypotherime injection of todin, 10 per cent (iodolena), in almond oil may be injected, intramiscultarly when the stomach is irritable or easily disturbed by the jodin salts.

If the atrophic process is ittended by thyroid deflecency, thyroid proteid extract or iodin (g: 1/12) prepared in eiths of gelatin (g: 1/12 to each cube—1 by 3/4 inch) may be given the eitings of g0 and g1/12 to make the either of g1 with milk, before eiting, in addition to iodin by electrophoresis. A general tonic effect on the glandular system may be produced by the soap both. The patient strips in a warm room and theoroughly covers the body with a thick lather of white cristile soap, the smallest quantity of water being used. A flesh brush is now quickly applied over the whole surface of the skin for a period of five minuties when the redundant lather is removed with a Turkish towel and sharp friction. The patient their returns to bed Tonics of strychinin, iron, or phosphorus exp. gr. 1/100 in oil should be continued throughout the treatment

Thorough local clerusing measures are essential. A plan of office and of home treatment should be chosen which shall involve simplicity, economy of time, expense, and effort. The methods adopted must be carried out through a long period of weeks or months. Results are obtained only by

RHINITIS

9

the exercise of patience and persistence. Especially with children it is necessary to use alkaline solutions that are pleasant in tiste and odor for cleansing purposes Of the official preparations the solutions made from Seiler's tablets, sodium chlorid, borax or boric acid are convenient, cheav and efficient Innumerable preparations have been marketed that contain these es ential ingredients, whose color and odor are made attractive. The efficiency and value of them however, depend upon their alkalimity and mild antiseptic properties. In severe cases where the crusts are dry and tenacious and show marked decomposition, potassium permanganate, 1/12 gr to the ounce, perovid of hydrogen or sol mercuric chlorid (diluted 1 7) 1 3,000, may prove of greater usefulness than the above-mentioned preparations These solutions should be warmed and either sprayed or avringed through the misal passages both anteriorly and posteriorly J C Teal reports pronounced results from the use of water soluble scarlet red (Biebrich ozo-benzin) After an alkaline douche or spray a 4 per cent scarlet red emulsion is applied to all parts of the nasal mucous membrano with centle massage. The application is renewed every forty eight hours although the odor and crusts may be absent after the second application If these measures are insufficient to remove crusts and infected secre-

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for the g dvanic current The appheation is usually followed by a reactionary hyperemia, and if any excessive irritation follows it may be allayed with a spray or appheation of menthol in petrolina oil. The appheation may be reperted duly at first and gradually reduced to twice a week. Missige is a fivorite method with many laryingologists. Institutionally apparatus. Kelligine claims to have treated over a thousand cases with marked improvement by urbartory and light attoling move ments applied by means of a sound 20 cm. in length. The instrument is covered with a rubble had over some cotton. The floor of the nose meet, inferior and middle thibute bodies, and septim are treated in order. W. Frendenthal has designed a good instrument for cumbulance letting a lightness many control with the mental ments of the control with the properties of the nose meet, inferior and middle the number obdies, and septime are treated in order. W. Frendenthal has designed a good instrument for cumbulance letting a lightness ments.

cuploting electrical vibratory massage. The tunpon suc-ested by Gottstein has been recommended extensively. This may be placed by means of a screw applicator into one passage and allowed to remain four or five hours, when the other passage is treated in a like manner. Various modifications have been devi ed by Percher, Hubbard and Leland, whereby pigments of ichthyol iodin, or an alcoholic solution of acctanilid are applied by this method. This plin is frequently annoying and obsorous to the patient, and may fail for this result.

The most efficient topical application is lodin, gr vii to vii, glycerin,

ass, aque, 3ss

Ichthvol, 20 per cent, argyrol, 20 per cent, or resorem, followed by a spray of menthol and camphor, 5 gr et alt to the ounce of petrolina oil are valuable. Special investigation by X ray and illumination should be made to determine the condution of the accessory sinuses. Proper surrical lossaures and ventilation often afford resaft relief.

# RHINOSCLEROMA

Rhimoseleroma is exceedingly rare in this country. Only 3 cases were reported in the United States before 1893. The pathology and treatment of this discree have been most carefully studied by Emil Mayer and Gertser of New York, and by Chiari, Ganghofner, and Paultanf of the Old World. Freudenthal has suggested the value of Coley's fluid or rhinoseler. The proposed by Pawlowsky. The nes of autogenous vaccine has apparently offered something of inhibitory value in a few cases. Five cases have come under the writer's observation with larynged involvement that were relieved for a time by dilatation with Schreetter's tubes. In Lubliners case the lesions disappeared after an attack of typhoid fever. More cury and iodids have been used extensively without success. Temporary relief has been accomplished with the various chemical custices. Palliative surregial methods are recommended in selected cases to relieve stenosis.

#### SINUSITIS

Acute Nasal Sinusitis - Acute inflammation of the mucous membrane lining the nasal accessory sinuses is a common complication of acute nasal catarrh In some of the grap epidemics involvement of the nasal accessory sinuses is extremely common The inflammatory process may be restricted to the sinuses on one side, affecting one or several simultaneously, or it may involve all the sinuses on both sides producing a condition of pan sinusitis. An acute abscess about the root of an upper molar or even a bicuspid tooth not infrequently ruptures into the antrum and produces an acute maxillary sinusitis Acute sinusitis is always associated with more or less marked subjective symptoms, which vary from a sensation of fullness or stuffiness on the affected aide to that of pressure or even severe pain over the region of the sinus involved that is over the frontal or maxillary sinuses or between the eyes The recognition of an acute sinus inflammation presents no great difficulty. The process can usually be suspected from the subjective symptoms complained of In addition to the sensations over the region of the involved sinus and the blocking of the nasal passage on the affected side there is usually pre ent a marked in crease in the resal discharge. The transillumination test will usually give a positive finding for both the maxillary and frontal sinuses, easily recognized when the process is unilateral (see discussion of Transillimi nation Tests under Chronio Sinusitis) The shiagraph will assist in mak ing the diagnosis especially in cases of frontal ainus trouble. Should the shiagraph leave any doubt concerning the maxillary sinus this can readily be cleared up by urigation of the sinus by introducing a cannula into the natural opening or he puncturing the nasel wall with a suitable instru ment either in the middle or the inferior meatus

The treatment of acute snussus is chiefly directed to the relief of the subjective sanations. If the mavillary sinus has become infected by a tooth aboves it is important first of all to have this abovess then care of by a dentist. The symptoms of anal obstruction are relieved by reducing the integescene of the mast mucous membrane. The simple t means for relieving this condition is by aveil arrigation using hot normal salt solution. In order to avoid the risk of currying the infection up the entachment the into the tympanium, it is best to direct the patient to draw the salt water up into the none. This can be facilitated often by the use of a traight glass tube with a sautable halb on the mastle and. A great deal of relief is usually afforded by spraying the nose with the following preparation mention gr 8 cumpbor gr 4 oil of eneals pussimisms 3 albeline or 2. The pritent should be directed to draw the albeliens spray bock through the nose. A weak solution of adrendim 1 10 000 sprayed into the nose is often an effective way of relieving the intrinasal

swelling. The most effective method for relieving the intransal obstruction is by applying with a cotton sub at ½, per cent solution of sec un in 1 10, 000 adrenalm along the under surface of the middle turbunated body. The subjective sensations of pr. sure and of prin result from the retention of secretion in those similes which have their openings under the middle turbunated body. This includes the maxillary and frontal similes, as well as the anterior ethnoid cells. The relief afforded by applications along the free edge of the middle turbunated body lasts usually for several hours and in some cases for the larger part of the day. Suction by means of a suitable apparatus may be employed to withdraw secretion from the accessory cavities in cases of acute sumains. The value of this method of treatment is secondary to that outlined above. The use of the electric light head both devised by Brunings is usually an effective method of releming intransal targescance and the subjective symptoms dependent on this condition. Severer cases should be lept in hed. Aspirin, 5 gr, repeated every three or four hours, often affords relief. In other cases, an opition my be necessary.

The necessity for treatment further than that just outlined for the relief of acito sinustitis arrives only in the exceptional case. One occurs on all, incoming a country a case where because of the fulluo to scenar proper drunge through the normal openings by the methods already given, the prim occasioned by the retention of sceritions becomes so severe that resort must be had to surgical measures. In the case of the marillary sums the enviry cur he irrigated by puncturing the navel will of the sinuscriber in the middle or the influior mentus. A few irrigations usually suffice to clear up the process. Should the severe symptoms persist, a large opening on be quickly made through the navel fontancl in the middle mentus.

For the relief of retention in the frontal sinus and in the anterior ethimoid cells a resection of the anterior end of the middle turbinated body will usually suffic. In exceptional exest tius may have to be followed by an exenteration of the anterior ethimoid cells. Irrigition of the frontal sinus by the introduction of a sinitially enabled will relieve the prin occasioned by the retention in this sinus. There are very few excess where all efforts to secure intrinseal draining for an acute frontal simistic fall. In these excess one may be forced to open the sinus by an external operation in order to relieve persistent severe pain.

Chronic Nasal Sinualus — Chronic influmnation of the naval accessory sinuses appears under several distinct forms. The trouble may be limited to one sinus or there may be unovlement of all the sinuses area on both sides of the nave. Chronic foci of infection in the nasal sinuses may assume an important part in the ethology of systemic infection. The close relation of the sinuses to the other permits of a direct extension in volving the eye, a condition which is particularly apt to occur from discusse.

of the ethmoid. The anatomical relation which frequently exists between the optic nerve and the posterior ethmoid cells and sphenoid sinus permits of an involvement of this nerve by an extension of the infection from these suntsis. The profit of dictarge of pus in some cases of chronic sinusitis draining back, into the pharms may even digestic disturbances. The ditection therefore, of case of chronic sinusitis and the institution of the proper method for relieving this condition becomes a very important question.

The symptoms complained of by the princip are not so characteristic as in cases of acute simistics. The persistence of a profuse purelier discharge from the noise should always arouse susperion of a chronic accessory simis discase. A unfateral discharge is particularly characteristic of sums cappenia. In a good many cases, the process is more or less latent and the trouble on the discharge is slight it will sometimes form in crusts about the amount of discharge is slight it will sometimes form in crusts about the nasid ornice of the affected sums. Headache is characteristic of chronic sumstits, especially during periods when there is some obstruction to the escape of the escretion from the sums or during the period of an acutic exacerbution of the chronic process.

The method of procedure by which the detection of chronic sinusitis is made consists in the fir t place of an intransal eximination by means of reflected light. Furnient accretion found in the no e should arouse suspicion of chronic sinusitis. The reappearance of pus in the course of a few minutes after the nabil pastiges have been carefully cleaned is proof that the secretion comes from some reservoir where it has been previously accumulating that is from an accessory sinus. If the pus reappears under the middle turbinated body that is in the middle meatus, it means in involvement of the maxillary sinus or frontal sinus or of the anterior ethmoid cells or of all three. If the pus reappears between the middle turbinated body and the septum, it can come only from the sphenoud sinus or the po terior ethioid cells. In a great many on es of chronic singuitis the amount of ceretion is so slight especially during the latent stages, that little or no ecretion is found in the no e and none reappears in a reasonable period after cleaning. The second step in the examination is to apply the transillmention test. Should this show a distinct shidow over one maxillary sinus while the other remains clear it should arou e strong suspicion that the sinus is involved and in case the shadow is on the side where pus was found to reappear in the middle meetus there is little room to doubt the presence of maxillary sinusitis Not infrequently when the bones are heavy transillumination leaves one in doubt, because of the presence of a shidow over both sinuses. When on the other hand transillamination shows the ab ence of a shadow on either side we are fairly safe in concluding that there is no maxillary sums trouble. The tran illumination of the frontal sums is not as a

rule conclusive because of the frequent occurrence of small sinuses which fail to give a positive difference on the two sides even when only one smus is affected. In many cases, especially where the sinuses are not small, the transillumination will be found so clear as to preclude the pos sibility of frontal sinus disease. In other cases, too, when the sinuses are not small the pre ence of a distinct shadow over one sinus, when contrasted with the clear illumination of the opposite side, leaves little room to doubt the presence of a frontal sums empyema, especially when this findin, is combined with the reappearance of pus in the middle meatus

In the cases where the intranasal examination and the transillumina tion tests do not exclude the possibility of sinus disease, a skiagraph should be made. This will be of value in determining not only the presence of trouble, particularly in the case of the frontal sinus, but the skingraph will also show the exact size of the frontil sinus step in making a positive diagnosis in suspected cases is by irrigation of the sinus in question This method has its greatest use in cases of maxil lary sinus infection The irrigation is accomplished by catheterizing the normal opening in the middle meatus or by puncturing the nasal wall of the sinus in the middle or the inferior meatus. If pus is washed from this sinus and reappears again in the middle meatus it must come from either the frontal sinus or anterior ethmoid, or from both Irrigation of the frontal sinus is not so simple and cannot always be accomplished, even after the anterior end of the middle turbinated body has been removed If pus reappears in the middle meatus after irrigation of both maxillary and frontal sinuses at can come only from the anterior ethmoid cells Irrigation of the sphenoid sinus is more readily carried out

This preliminary discussion of the detection of chronic sinusitis will help to clarify the problems one encounters in relieving these conditions Not infrequently a tooth absects has been the starting point for a chronic maxillary sinusitis which in turn has infected the other sinuses on that side It is important in such cases that the offending tooth be properly taken care of first of all The primary factor in the successful treatment of mo t cases of chromic sums disease is to secure adequate drainage and ventilation of the sinus. This accomplished, the condition often tends to heal without further treatment. In the case of the maxillary sinus, this drainage can be accomplished by making a sufficiently large opening either in the middle mentus in the region of the nasal fontanel, where the most fragile part of the nasal will of the sinus is found, or under the inferior turbinated body A large permanent opening made in this way is usually sufficient to bring about a cure of chronic maxillary sinu sitis The operation may be followed by duly irrigation with a warm normal salt solution through the opening into the sinus. This the patient can be trught to carry out by himself for a few weeks until the pathologic secretion has disappeared In intractable cases a more radical operation may be cilled for This consists of making an incision under the upper lip and lifting the periosterm over the anterior wall of the sinus. This wall is then removed and a greatly thickened mucous membrane in the sinus curetted away. The operation is completed by making a largo permanent opening into the infe for meatus of the nose.

The cure of chronic frontal sinnsitis is undertaken in the same way by securing adequate drainage into the nose. Since the frontal sinus disease is usually complicated by a more or less extensive involvement of the anterior ethmoid cells the first step in securin, drimage for the frontal sinus is the removal of the unterior part of the concha media, followed by a partial or a complete eventeration of the ethmoid cells, depending on the extent to which they appear to be involved Finally an effort is made to increase the size of the nasofrontal opening. Con sidering the relation of the ethmoid cells to the orbit and to the cribriform plate it is evident that operations in this region should be undertaken only by those who have made a most careful study of the regional anatomy of this part and are also perfectly familiar with the technic of intra nasal operations. This operation for securing better disinage from the frontal sinus may be followed by regular daily irrigation of the sinus with a warm normal salt solution. This too as a rule the patient can acquire the ability to carry out at home. Many cases of chronic frontal sinusitis go on to a perfect recovery after this treatment has been carried In other cases the trouble persists because of permanent altera tions in the membrane lining the sinus usually in the form of polypoid degenerations which are sometimes found completely filling the cavity of the sinus The disfigurement more or less marked which is certain to result from the scar of an external operation on the frontal sinus is a contra indication to this procedure, except in unusual cases where, after every effort has been made to secure relief by drainage through the intra Basal route the severe pain continues or symptoms of an intracrinial extension appear

The radical treatment of chronic empyema of the ethmoid labyrinth or of the sphenoid suns is much simpler. This consists in the eventeral tion of the ethmoid cells and the resection of the anterior will of the sphenoid sunses. Both of these operations are now feasible and are carried out intransacily by the specialt shilled in the technic of this sort of work. Sometimes it is not feasible to accomplish the complete exenteration of the ethmoid labyrinth at one sitting and in these cases repeated sittings require a great deal of prisecretance both on the put of the patient and of the surgeon to search out and drain all infected cells. Even a small concealed poelet of pins in such cases may constitute the focus for the persistence of a most scrouls systemic infection.

The results obtained in the treatment of chronic nasal sinusitis may

be summed up as follows By securing adequate drainage by intranasal operations most cases can be permanently cured. The sinus most likely to persist in discharging pus in spite of this treatment is the frontal sinus, and here the advisability of an external operation is particularly contraindicated because of the conspienous soir which must result those cases where by intranasil surgery we fail to bring about a definite cure of frontal sinusitis, this treatment affords in most instances relief from the chief symptoms complained of, namely, frontal pain, occa sioned by the obstruction to the outflow of pus from the sinus The com plete elimination of foer of infection from remote ethnoid cells presents great difficulties and these may be met with when an external operation is undertaken as often as when one relies upon intrinssal surgery. The complete eradication of chronic foci of infection, therefore, in cases where these are suspected of eausing systemic disease may not always be entirely feasible, especially where such foer are located in remote ethmoid cells or in the frontal sinus

Hyperplastic Ethmoiditis -In connection with chronic necessory sinus disease mention should be made of the condition of polypoid de generation of the mucous membrane lining the ethmoid cells, as well as of the membrane about the nasal errifice of these cells, especially of that cover ing the unemate process in the middle meaths. This form of cthmoiditis is not primarily a suppurative disease. It is not uncommon, however, for a subsequent infection of the ethnical, such as frequently occurs from an attack of influenza, to produce a suppurative condition which, because of the impaired drainage occasioned by the presence of polypi, is very proue to become chronic This condition of poly poid degeneration of the ethinoid seems often to be predisposed by the presence of an anatomical variation whereby the normal ventilation and drainage of the ethinoid cells are readily impaired. A large percentage of the cases occur in patients where the coucha media is wedged so tightly between the septum and the outer masal wall as to practically close the middle meatus, into which the chief cthmoid cells open. The anatomic il relation is such that but a slight con gestion of the micosa of the nose is required to close tightly the openings of the cells The symptoms observed in these cases, particularly in the early stages are chiefly attacks of sneezing associated with a profule watery masal discharge. There may be at times a sensation of fullness of pressure between the eyes The voice often lacks its normal resonance rust as occurs frequently in scute coryza Sooner or later in a great many of the cases distinct symptoms of asthma develop. Indeed, it is rather the exceptional case of asthma where distinct evidence of a hyperplastic ethmoditis cannot be detected. A casual examination of the nose very often fails to discover this condition, for the reason that an inspection of the middle meatus is interfered with because of the anatomical condition described above and by the time the polypi begin to make their appearance

from under the concha media the change in the ethmoid cells is already of long standing. In uch cases, where because of the symptoms one is led to suspect a hyperplastic ethmoiditis it is necessiry by means of a long bladed nival speculum (a Kulhan speculum), to priv open the middle meatins in order to detect evidence of beginning polypoid degeneration. The condition is of course a chronic one and there is no tendency for a spontaneous recovery. In the early tages the improved ventilation of the conchimed cells, accomplished by the resection of the unterior half of the conchimedia, second soft in the sufficient to bring about a cure. In the conchimedia only the complete eventeration of the ethmoid labyrinth by a radical intransal operation will be of permanent value. These operations bring relief more frequently of the structly assal symptoms thun they do of the is ociated asthma. Failure to care the asthma in some cases may depend upon our includit to eccomplish such a complete exenteration of the ethmoid cells as to prevent the recurrence of polypi.

#### **EPISTAXIS**

In the treatment of epistanis or "noschleed," it is of the utmost importance to determine the causal factors A careful examination with a good light and navil speculum should be made. The traumatic varieties will call for topical applications. The simple dome the methods of relief such as holding the lunds above the held, the application of ace to the also and not of the nose may be sufficient. As the majority of simple cases come from a rupture of the septial artery at Kesselhich's spot, a short distance within the vertbuile a cotton tampon inserted and resting over this area, with pressure from the outside will promptly arrest an ordinary hemorrhage. The tampon may be saturated with adrenalm chlorid (1 4,000) or eocam and antipyrin (each 2½, to 5 per cent.) hy peroxide thydrogen or thromboplastin. In every case that is not relieved by these simple methods the bleechin, point should be found and treated. The habits and constitutional dy crasia of the patient must be carefully studied.

In atheromatous subjects or those with high blood pressure epistaxis is often a safety valve of nature that may prevent impending disaster in a more remote region of the body. When the bleeding from the septial artery or from granulations on the turbinate bodies is excessive or recurrent the application of trichloracetic acid the intrate of liver stick or the giranocautiery point (applied and removed at red heat) will give prompt results. When the tehnodal arteries are bleeding, a bismuth or rodoform gruze tampon to the roof of the no e will price successful.

If the anterior method of musul tampon is cho en it is essential that either dressing or musul forceps with fine blides should be used, and strips

be summed up as follows By securing adequate dramage by intranasal operations most cases can be permanently cured. The sinus most likely to persist in discharging pus in spite of this treatment is the frontal siuus, and here the advisability of an external operation is particularly contraindicated because of the conspicuous sear which must result In those cases where by intranasal surgery we fail to bring about a definite cure of frontal sinusitis, this treatment affords in most instances relief from the chief symptoms complained of, namely, frontal pain, occa sioned by the obstruction to the outflow of pus from the sums The com plete elimination of foci of infection from remote ethmoid cells presents great difficulties and these may be met with when an external operation is undertaken as often as when one relies upon intringsal surgery. The complete eradication of chronic toes of infection, therefore, in cases where these are suspected of causing systemic disease may not always be entirely feasible especially where such foci are located in remote ethmoid cells or in the frontal sinus

Hyperplastic Ethmoiditis -In connection with chronic accessory sinus disesse mention should be made of the condition of polypoid de generation of the uncous membrane lining the ethmoid cells, as well as of the membrane shout the nasal orifice of these cells, especially of that cover ing the uncinste process in the middle meatus. This form of ethmoiditis is not primarily a suppurative disease. It is not uncommon, however, for a subsequent infection of the ethmoid, such as frequently occurs from an attack of influenza, to produce a suppuritive condition which, because of the impaired drainage occasioned by the presence of polypi, is very prone to become chronic This condition of polypoid degeneration of the ethmoid seems often to be predisposed by the presence of an anatomical variation whereby the normal ventilation and drainage of the ethnoid cells are readily impaired A large percentage of the cases occur in patients where the concha media is wedged so tightly between the septum and the outer nusal wall as to practically close the middle meatus, into which the chief ethmord cells open The anatomical relation is such that but a slight con gestion of the mucosa of the nose is required to close tightly the opcurings of the cells The symptoms observed in these cases, particularly in the early stages, are chiefly attacks of sneezing associated with a profusi watery nasal discharge. There may be at times a sensation of fullness or pressure between the eyes The voice often lacks its normal resonance, just as occurs frequently in neute corvea Sooner or later in a great many of the cases distinct symptoms of asthma develop. Indeed it is rather the exceptional case of isthma where distinct evidence of a hyperplastic ethmoiditis cannot be detected A casual examination of the nose very often fails to discover this condition, for the reason that an inspection of the middle meatus is interfered with because of the anatomical condition described above and by the time the polypi begin to make their appearance

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prove the general physical condition and to prevent the chemical changes which unhealthy secretions undergo. It is only by the utmost diligence that stuffactory results may be obtained

The patient should be instructed in the use of the antiseptic alkaline solutions such is Sciler's and Dobell's olutions, or compound antiseptic powder (U S P). It is often necessary to soften the crusts with vaselin or liquid petroleum before the cleansing wish is used. This routine on the part of the patient should be followed by efforts to prevent effective crust formation and its decomposition. Internal administration of the todd of iron, cod liver oil, phosphorus, stryching, or arsenie will be frequently indicated. Plenty of outdoor life and everses with good nour ishing food should be ordered (see Atrophic Rhinitis).

The special triatment of this disease offers many different plans and agents under the theory of the infective character of ozena. The hypo dermue use of antidiphthentic serum has been proposed and highly recommended by Gradenigo. The duration of treatment varies from thirty to saxly eight days during which time 5 000 to 48 000 units of serum were employed. Perhaps the most efficacious local application is a 2 per cent solution of creolin followed by ichtivol 20 to 50 per cent and a mixture of todin and oil of cloves. Missage and electricity are beneficial methods of treatment. In some cases the stimulating effect of iodin gr. 48 potassium iodid 16 gr., water 1 ounce, giveerin 1 ounce is followed by improvement.

The hypodermio injection of iodin is highly recommended. This may be given in the 5 to 10 to 20 per cent preparations in aliand oil (tode-laine). The stronger preparations are more or less painful. A spray of buchlorid of mercury, 1 \$ 5000 is an excellent medicament in cases that are possibly lunte in origin. Remarkable results have been claimed by Horn of San Francisco from the use of a vaccine prepared from the isolated infecting incrooriginum which he claims is the titologic factor. Thorough surgical attention to the puthology of the sinuses must not be neglected.

of gauze, 1/2 inch in width, passed well back into the posterior portion of the nasal canal, followed by others until firm and uniform pressure is effected. The gauze may be siturated with suprarenal extract, or dusted, if necessary, with tunnegallic acid powder. The use of Monsel's solution, chlorid of iron, or other powerful astringents is a method of last resort, but objectionable on account of forming hard clots.

In severe postoperative epistavis, or in persistent hemorrhage after the simple methods have fuled, it may be necessary to use a posterior tempor. This is prepared from cotton or gauze by trimining and folling a suitable piece to a size that will enter the posterior opening and not caush pass forward into the nasul passage. It should measure for an adult about 1½ be 7% inches. A string should be pissed around the middle of the tampon, leaving two long ends. A small soft eitheter should be passed through the hieleding side into the planyin, where it is seized with a long forceps, and the cord drawn out of the mouth cavity. One of the free ends of the string is ted firmly to the eatheter and the latter withdrawn through the nastl passage while the tampon is forced genity into the posterior opining by the index finger of the free hand. The ends of the strings from the no e and month are then fixed with atherise plaster.

Internal medication is especially indicated in cases of renal or cardiac (viscular) disease attended by high blood pressure. This may be accomplished by the use of interure of account on drop doses of 3 to 5 drops at once. Nitroglycerin (gr. 1/100) by podermically will act promptly, or this prepriation may be given every half hour for three or four doses if the blood pressure is low intertire of digitals (minums 5) every hour for three doses, or camphor, or ammonia, will be more beneficial. When the hemorrhage is continuous or profuse, hydrastinia hydrochlorid (gr. ½) or styption (gr. 1/3) hypodermically may be efficiencous. In persistent cases due to hemophilia ancients or allied disorders the hypodermic use of antitovin or freshly prepared horse serum is of value. Calcium lactate in 16-gr. doses hourly, by raising the coagulation point, may be necessary Gelatin in large quantity has a similar influence. The use of ergot is unscientifie and harmful from the fact that valuable time is lost. Therefore a more suitable remedy must be chosen. In recurrent and persistent epistaxis the presence of postnasal interation or a tumor, or the possibility of pulmonary hemorrhage, must be climanated.

## OZENA

While comparatively few cases of recovery from ozena are reported, yet in the majority of cases it is possible to outline a plan of treatment that will afford great comfort and temporary relief. This plan should always begin with thorough cleansing of the parts. It is important to im

maxture is added to a pint of boiling water and placed in the inhalter or pitcher. The medicated steam is inhaled as hot as possible for five to ten minutes. This may be repeated at hourly intervals. Oil of eucallyptus in the proportion of 1 ounce to the quart of water may be used in the same manner or boiled over a spirit lamp.

Oleum terebuthinge oleum pun, and oleum puniperi are also to be remembed, to be used in the same way. When the larving is dry and a toking, sensation with a short frequent cough is present, their tartar emetic in careful dosage is indicated. This may be administered pleas antly to adults in the following preserption

$\mathbf{r}$	Antimonii et pots su tartratis	gr s
	Tincture ipecacuanha et opii	3s
	Liquoris potassii citratis	້ວນ
C	Er orome to a Louise	

Sig 51 every two hours

Some of the various loxenges that contain ammonium chlorid or menthol and camphor are very acceptable. In very young children a powder containing ½ to 1 gr of cinchoniu with 1/12 gr of specie will often give great relief. The cough in adults may be reheved with heroin gr 1/12 to 1/24.

Local Treatment—The upper pa sages should be clemed with a spray or nrigation of warm normal salt solution. Dobell so it he Seiler solution may be preferred. An attempt should be made by cerey practitioner to eliminate from use a vast list of proprietary preparations which are to be found on the shelves of the livit and which are used to the detriment, many times, of the delicate massil mucous membrane of the patient. The therapeutic properties of these solutions are generally based upon the ingredients of the original solutions of either Seiler or Dobell. Many of these proprietary solutions are compounded of inferior materials and of a strength (of solution) that is not only harmful but frequently permanently injurious. The choice in the U.S. P. of salt, Dobells or Seiler's solution, Puly Antiseptic Comp., etc., is amply sufficient for field all indications.

In inhibition spray of mention and camphor gr 11 to the ounce in his blocker is valuable and soothing especially in the dry stage of the attack. In 18e the spray effectually the unterror portion of the tongue is to be wrapped with a piece of gauze, then extended and held by the puttent while the air of the nose are compressed by the operator present used respiration. The puttent now inhales and exhales while the spray is continued. By this method the nincous membrane of the larrux is more quickly and theroughly treated. A down spray, consisting of alun (gr x), and carbolic (gr 11) giverin (12, ounce) to 12, ounce of water may be applied directly to the larging with benefit. Strong

### CHAPTER II

### DISEASES OF THE LARYNX

BURT R SHURLY

## LARYNGITIS

Acute Laryngitis-Prophylactic and Internal Treatment-The prophylactic and internal treatment of acute larvingitis, or acute larvingeal caturrh, has much in common with acute inflimination in the nasal pis sages, hasopharyng, and pharang. The use of aspirin and Dover's powder (in 3 to 5 gr dos ige) is beneficial and comforting. The use of the voice should be forbidden, as rest is an essential measure, especially at the outset or early stage Advice in this regard must be firm, as rest will decidedly favor other abortive measures. The upper respiratory envities should be examined, as acute larringitie is rarely the primary affection, nevertheless the attending acute inflammation should receive court atten Small and frequent doses of functure of acouste root, 1 to 2 minims every hour until the constitutional effect is noted, will often relieve local congestion and the pyrexia. If pun be prominent aspirin often gives prompt relief It may be administered in rheumitic subjects together with saliem. In mulirial districts the addition of quinin is advantageous. The early use of calonicl in 1/10 gr doses until ten or fifteen are taken is advised. This should be followed by the usual siline in the morning. The cold compress over the largax, covered with an oiled silk pad, is grateful to many patients. The ice collar or Leiter coil may be adopted if convenient However, the danger of additional congestion of the parts after continued hot applications males them of doubtful utility A room saturated with moist soda steam is grateful and comforting A cropp tent may be improvised and supplied with alkaline sterm (soda brearbonate, I ounce to a quart of water) from a kettle to which a price of garden hose has been attached to the spout Various steam inhalers are in the market A pitcher of boiling water with a cornucopia of paper placed over it as an inhaler affords a satisfictory method of supplying a medicated vapor A favorite and useful formula is menthol, gr 11, tinet benzoin comp, 3ss, tinet opin comp, 3ss A tenspoonful of the 20

strength of zinc chlorid gr x to I (0.6 to 3.0 gm), intrato of silver, gr v to xxx (0.3 to 2.0 gm) rights, 10 to 5.0 px cent may be introgred in the larvay with beneft. Larynguts resulting from recurrent unfection should have proper surgical trutheatt for adenoids, tonsils or account sincers according to the foct of infection pre-

Edematous Laryngitis —Fdema of the larvax requires active treat ment by a brisk cathartic of calomel followed by magnesium sulphate or elatrning, gr. ¼. Alkaline stem inhalations hot astrin_cut grigits a mustard countentritation over the larvax, followed by ice-bigs to the ucck, should be ordered at once. If the patient is styphilitic and potassium iodid has been administered it should be discontinued immediately as this drug greatly aggravates the condition of some patients. A spray of adrenulin (1 10 000) through the nose and into the larvax may temporarily relieve It uses is attended however with the druger of rectionary swelling.

When edema follows the entrance of a foreign body or after bron choscopy or the removal of an intubation tube the u e of codem or Dovers powder to allow the restlessness may be valuable. Pilocarpin is favored

by some, but its depressant effects should be considered

This condition in usually a scenared with asstering discuse such as wishins, tuberculous investions, creamona, bulbar piralysis or cardine, reaal, and hepatic disorder, and appropriate diagnosis and general therapy are required. If the edema does not respond to the simpler measures and exanosis intervenes securification of the affected region of the livrax should be undertaken. A 20 per cent solution of cocain should be sprived or applied over and into the livrax and the excess swallowed. Service ton should be performed under the direction of a larvaged mirror and reflected light. A larvaged livray and reflected light is a larvaged livray and affected light in the larvaged livray and transudation are usually beneficial. If the dyspuea continues and urgent symptoms develop scarification could be repeated with a guarded bistoury under direction of the index fuger.

In great emergency intubation or tricheotom; must be performed. The former operation is often difficult. If one or two trials are not suc

ce sful tracheotomy should be performed without delay

Spasmodic Laiyagatis—File croup laryagasums stradulus or spas modic croup requires prompt difficential diagnous. In children subject to attacks, adenoids, hypertroplated torsuls and clongated uvul) may require operation. Yold sponge over the chest, neck and region of the laryax may be valuable. Gastro-metsurid disturbances should be avoided by circfully selected duct. During an attack treatment directed toward rela-vation of mic cular spasm must be administered. A hot bath and a teaspoonful dose of syrup of spaces are favorite and efficient household remedies. Wine of antimony (1.2 drops) or antimony and species (as gr 1/100) every affects amuntes until emesis results may be given a astringents should be used only exceptionally Temporary relief may be obtained by a laryngeal spray of adrenalm 1 10,000

In children, in whom edema develops frequently, a dose of turpeth mineral or syrup specie, used as an emetic, together with a prompt steam inhaltion, will afford suitable means of ichief.

Intralarvageal appheations are of benefit in the subroute stage, as argyrol, 20 to 40 per cent, or alumnol, 20 per cent. Sprains of the glottis may prove annoying, and dangerous in some cases. Anodynes such as heroin, codein, or opium, by month or hypotermically, will promptly allay the nervous phenomena in such cases. Intubation, or even trachectomy, may be necessary in rare occasions.

It is important to adopt ever therepeutic measure to maintain and persecute the general good condition of the princit. Reconstructive or nerve tonics, such as mux comics and strychim, with quinni and ron, are frequently indicated. The use of alcohol and tobacco should be prohibited during an attack.

Chronic Laryngitis -This condition may appear as a hypertrophic, a subglottie, or a pachydermatous variety. The hypertropline form may exist with chorditis uodosa, fumiliarly known as 'singer's nodes," and usually located at the junction of the anterior with the middle third of the vocal cords The various forms of systemic disease and focal infection must be investigated and treated accordingly. The value of a warm, dry olimite must be considered, but recommendations must be based upon the financial and general condition of the patient, the age, and possibilities of travel, etc. Conditions causing masal stenosis and pathologic areas of hyperplastic gland tissue must be surgically removed. Attacks of indiges tion, gout, rheumatism and syphilis should be modified by proper systemic treatment and the removal of foci of infection. In cases that develop nodes a six months rest is nece sary. The use of alcohol and tobacco should be forbidden Internally, potassium iodid, 10 to 15 gr (0 6 to 10 gm) t i d may be given with eaution to assist in the absorption of hyper plasta Locally, the use of causties or astringents is frequently indicated The former should be applied by the skilled specialist of experience only. The fused nitrate of silver or the galvanocautery may be the methods of greatest usefulness Locally, laryngeal sprays of alumuol, alum, or zine, preceded by a spray of Seiler's solution, aid in giving comfort to the patient. They are of no curative value. The same may be said for oil sprays, such as menthol and camphor in albeine. Laryngeal appli cations should be made with great care and only with a reliable instru ment, as the Mackenzie, that will hold firmly the proper sized cotton The excess of solution must be carefully removed

^{*}In most cales in children the administration of bround of potassium is promptly followed by relief in spasmodic crosp whether due to laryngitis or a purely nervous mechanism.—Editor

croup tent with an open umbrella and a sheet. The vapor of slaked limo may be substituted for storm of alkaline water or alternated with it when these methods of treatment are medicient to relieve an increasing dyspine the indication for intulation or trackedomy must be considered and promptly adopted. The former operation should be closen, if possible because it is quick, paulies, and efficient. Antitoria and intubation will save four out of every five cases in the later stages of asphyria. Convalescence will be favored by full do es of tinet. ferri chlor, well diluted with eliverin and water.

Chrome Atrophie Laryngitis - Laryngitis sicca, or chrome atrophic laryngitis usually attends similar manifestations in the upper air passages Pilocarpin in 1/10 gr dosage, three times a day, by aiding general glandu lar activity, may prove of service Phosphorus (gr 1/100) in oil, in capsule or iodid of potassium are also indicated When a laryngeal spray is used the patient should hold the tongue with a piece of gauze between the thumb and index finger The operator then holds the nose, and deep inhalations are taken. The use of a menthol (0 30 gm), albolene (30 00 e c ). Dobell s solution as a down spray can be used to the larvax and proves grateful Of the local applications 5 to 10 per cent oleum picis or argyrol (50 per cent) or schihool (20 per cent) are most efficient Numerous remedies have been advocated, such as inhalations of ben zonated steam, applications of (2 to 5 per cent) thymol in petroleum oil camphor (5 per cent) in oil, zine sulphate (1 to 3 per cent) When the traches is involved intratracheal injections of menthol guaracol, and camphor in olive oil will prove beneficial Good results cannot be obtained, however without eareful treatment of the upper passages at the same time (see Atrophic Rhinitis) Hypodermics of the green citrate of iron have a useful tonic action

## TUBERCULOSIS OF THE LARYNX

Trestment may be clas fied as prophylactic highenic, climatic, specific symptomate local surgical, and general. There is a popular belief among the lativ that so-called catarrhal affections of the nose, throat and large lating the lativity of the second tribution of the

The prophylactic treatment of this affection is grouped around our conception of that which will best promote immunity. This involves the problem of the fight against infection and the predisposing factors of heredity.

Prophylactic treatment is particularly the field of the family physician

two year old child Turpeth mmeral (gr 11) was formerly used by many practitioners, but two fattl cross reported by McPhedran proved the danger possible from its use Antimony may produce depression, and not more than three doses should be piven

Alkaline steam inhilition is useful from a croup kettle or improvised apparatus. Tincture benzoin compound with parcgorie (equal parts), a terspoonful to a pint of hot water, offers a soothing inhalation. Poultices, stupes, or antiphlopistic preparations are bineheial, but the child must remain indoors for several days if they are used.

The attack is hable to recur on succeeding mights unless an antispas in the constitution of the broand of sodium or of potassium may render all other medication unnecessary, except local applications. Plenty of fresh are should be allowed, unless the atmosphero is damp and cold. Calomil and milk of magnesia may be presented with advantage the day following an attack, or an enema of soapsaids and water may be ordered at the first visit. If nutrition and viality are lowered, carefull regulation of the diet and tonic treatment are recommended. In adults when the spasmodie attack is chiefly nervous a hypodermic of morphin (gr. 1/4,) will afford prempt relief. This medication should not be repeated, and it is unwise to inform the patient in regard to the drug or desage used.

Membranous Laryngitis—It has been est hillsheld after much discus

sion and experience that membranous croup must be considered (and treated) as a klebs Loeffler infection Therefore antitoxin in full dosage (5,000 units) must be given at the earliest possible moment. This aviomatic practice is so important that no time should be lost in administering this specific, even if a doubt of the diagnosis exists in the mind of the practitioner We know that death occurs rapidly from mechanical obstruction of the larynx and not from absorption and the greatest haste is imperative, especially in children of the so called croupy and Treatment should be initiated with a brisk calomel pur, o followed by milk of mag nesia. A culture will give valuable information in regard to the variety of microorganisms present. This culture may be taken quickly from the epiglottis and arytenoid region by bending the platinum loop or cotton carrier to a proper angle. It is unwise to use strong emeties in this form of croup, us the depressant effect is often marked and the stomach becomes quickly deranged Cold compresses, a better the ice collar, will be found agreeable and serviceable throughout the attack The inhalition, almost continuously, of steam from alkaline water is indicated from the onset An albolene spray containing menthol is soothing to the larvny and allays the painful and dry condition of the membrane Calomel sublimation may be advantageously used Ten to 15 gr (06 to 10 gm) of the pure powder may be incinerated slowly on a hot shovel or on a piece of metal held over an alcohol lump Inhalation is facilitated by constructing a

eroup tent with an open umbrelli and a sheet. The vipor of slaked lime may be substituted for steam of ullaline water or alternated with it when these methods of treatment are insufficient to relieve an increasing dyspinea the indication for intulvition or trachectomy must be considered and promptly adopted. The former operation should be chosen if possible because it is quick, panalese vaid efficient. Antitoxin and intubation will save four out of every five cases in the later stages of asphvaia. Con valescence will be draved by full doses of tract ferri chlor, well diluted with giveenia and water.

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Treatment mvt be classified 'as prophylactic, hvgienic, climatic specific symptomate local surgical and general. There is a popular belief among the lait; that so-talled estarrhal affections of the nose, throat and larjur lead to tuberculous. It is exceedingly difficult to prove the secentific truth or falsity of this assertion. It must be remembered that the larvageal tuberculous is practically always an infection secondary to a pulmonary focus.

The prophylactic treatment of this affection is grouped around our conception of that which will best promote immunity. This involves the problem of the fight against infection and the predisposing factors of heredity.

Prophylactic treatment is particularly the field of the family physician,

who becomes necessarily a student of a predisposed individual. If the treatment by fresh nir, sunlight, forced feeding, and carefully directed excress his any curative value during the progress of the disease it must in all certainty have untied value along prophylactic lines

Children who bear the earmarks of tuberculous heredity, who are exposed at home to infection, and who show well defined signs of latent danger, should receive the timely advice of the family physician as to occupation habits of life, diet, and general bygene. It is recognized that the difficulties of good results are extremely numerous among a class of individuals who take unkindly to discipline, but the problems of prevention cannot be solved without early diagnosts by the medical profession and pausitaking erro of the subjects under exposure.

The bygienic treatment requires proper clothing sufficient but not too frequent bything digestable and nonrishing food, out-of door life with properly ventilated or open air sleeping apartments. Coal gas, air lader with organic matter as found in our cheap theaters and public halls, the use of tobacco, ice, and alcoholic drinks are irritating to these lesions. The use of the voice in larvingial philissis should be proliibited or moderated. This rule of rest or everyise is as important in larvingial involvement as in

the pulmonary varieties

The influence of climate is well recognized by the profession and laity In laryngcal infections that complicate a far idvanced pulmonary involvement advice to remain at home is much more valuable than a recommen dation to seek some indefinite place in the western country. Far advanced tuberculosis should be fought at home, and no patient should be allowed to seck new environment without sufficient financial resources Usually a warm moist climate improves the inflammatory and catarrhal condition of the larvny but as the pulmonary lesions do better in a dry, warm climate with altitude it is advisable to study the condition and, when possible, recommend sanatorium treatment in New Mexico, Arizona, or selected parts of Southern California It is essential that medical upervision should be obtained for each patient, and the family physician or specialist who firmly believes that elimatic treatment offers for his special patient something of genuine benefit should direct him with great care to some competent practitioner or chief of a sanatorium in the region especially indicated When the local lesion is in the early stage, these patients do well at a considerable altitude (6,000 feet)

Many cases under careful superasion improve satisfactorily in the lower altitudes—below three thousand feet—at which place they must receive the full benefit of all therapy other than climate Discomfort and distress are increased during the wind and dust storms of some of our favorite Colorado and New Mercor resorts

Some remarkable arrests and cures have been obtained among laryn geal and pulmonary patients sent to an altitude such as Silver City, New Mexico, about six thousand feet In this region the altitude is played against the latitude, resulting in cool or cold rights with warm or hot days

Patients with tuberculosis of the upper air tract without much pul monary involvement will improve and obtain great comfort from an ocean

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The numerous specifies that have been brought forward from time to time for the cure of the various forms of tuberculosis have fulled to establish the claims made for them. Skeptiesim and therapentic milhism are unjustifiable however as a refulness may be found for many of the remedies, in selected cases. Unfavorable results in therapentic procedure in tuberculosis of the upper tract are largely due to the fact that many of these minifestations, and the larvinged forms in particular are almost invariably attended by pulmonary infection of more or less virulence. In a large experience during twenty five years the writer has not seen a case of primary laryinged tuberculosis in private practice.

Amon, the modern so-cilled specifies may be mentioned tuberculin in various forms with or without vaccines seri and antiovins, indin, chlorid of gold and sodium, ercosts formalin, oil of cloves, and nuclein. In

addition may be mentioned the X ray and radium

While brilliant results have been obtained when these sera or drugs were used the test of time has proved their failure. It is very important to differentiate between tub-reulous chrome, and syphilitie laryngitis be fore a definite plan of treatment is adopted.

Direct sunlight to the larvax stands out preeminently as the most use ful remedy discovered up to the pre ent time. A special apparatus modi fied by Forster of Colorado Springs consisting of a larange il mirror and an adjustable looking glass with a bracket that may be attached to the back of a chair allows the raya of the snn or those of a suitable 1 ,00 witt lamp to be reflected directly into the larynx. The patient treats himself daily beginning with a one minute exposure and increasing with the toler ance of the larvnx Tuberculin may be used hypodermically. The selection of the dose a study of the individual, a most watchful care of the patient, and careful attention to the rules of administration are essential to successful treatment. Potteneer shows that we have manifest evidence. of its value in tuberculous laryngitis where in small infiltration and even ulceration great improvement and cure may be looked for in a large per centage of cases Trudeau advances important rules for consideration He advises a minute dose of 1/10 000 or 1/20 000 mg of the solid substance of Loch's buillus emplsion or 1/1 000 mg of old tuberculin in creased very gradually, and at intervals that will produce as little disturbance as possible. At the slightest evidence of intolerance such as irritation at the site of injection or slight temperature reaction the in terval should be lengthened and the dose diminished. No injection should who becomes necessarily a student of a predisposed individual. If the treatment by fresh are, semlight, forced feeding, and carefully directed exercise has any curvative value during the progress of the disease at must in all certainty have untold value alon, prophylactic lines.

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In the writer's experience many cases have been favorably influenced by the use of Denv's filtrate (B F), beginning with 1/50,000 or 1/100,000 mg and increasing with extreme cure at weekly or biweekly intervals to avoid every possibility of a reaction. Fulling comes from thegaming treatment with too large amounts, rusing the dose too rapidly or at too short intervals, repeating the dose before all effects of a reaction have passed increasing a dose after a reveloin, neglecting milaise, head ache, annersia, increased temperature, cough, and expectoration as indications of a limit of tolerance. When a reaction occurs or when anemia as associated with the tuberculous leasons valurible assistance during the interval may be obtained by the hypodermic use of the green citrate or iron (gm 0.0) and sodium aremate (gm 0.001). This method of medication saves a delicate digestive apparatus for other usefulness, and affords a stimulating and reconstructive treatment of great and as yet unrecognized value.

In cases mixed with syphilitic infection mercury and iodin will fur mish the best results. The biniedid of mercury (gr 1), pota sium iodid (3ss), cinnamon water, and distilled water (511) each in teaspoonful doses three times a day will produce a startling effect in properly selected cases Its administration in lesions of strictly tuberculous type is often detri mental and contra indicated The use of phosphorus (gr 1/100) in 10 to 15 minims of olive oil in capsulo is beneficial in the more chronic cases It should be given after a full meal and promptly discontinued if irrita tion of the stomach, urticarious eruption, or aphrodisiac effects follow Symptomatic remedies are necessary to allay cough, tempera ture pain, diarrhea, and mental distress from time to time. Heroin (gr 1/12) or codem (gr 1/8 to 1/4) are efficient drugs to relieve the irri tation of the larvax They should be administered with cution and not until decidedly indicated Aspirin, guaracol, and quinin will control tem perature when necessary If alcohol is demanded the mult beverages and preparations other than spirituous are preferable. Rectified spirits in milk is better than whisky brandy, or rum. While in diarrhea and pain, opjum or morphin may be necessary, their use should be postponed as long as possible. Sleep may be secured by veronal or trional if absolutely indicated

The prescribing of depressing drugs should be withheld from patients who offer a hope of cure, as the resistance may be undermined by the prostration, interference with elimination and normal digestion that at tend their constant use

The local treatment consists of the inhalation of gises or medicated air in sprays or powders and the application of drugs to the affected region

Among the many ingenious methods of local therapy that have been advocated, a few useful pull-interes may be mentioned. Reference may be mide to some special textbook if the complete list is desired.

Before treatment is administered, a spray of Dobell's solution should be used to remove sceretion from the larger the application of formalin in gridually increasing strength is precumently the most beneficial remedy. It should be prepared daily from a 40 per cent solution and the unitial strength should be 3 per cent in giverin. Until the tolerance of the larger is obtained the pagment may be used in \( \frac{1}{2} \) per cent strength, increasing, to one and gradually to 10 per cent. Two per cent occain may be used if much pin is encountered. The preparation of Lake combines formalin (7 per cent), lactic acid (50 per cent) giverin (20 per cent), water (to 100 per cent). The application of lactic acid (20 per cent) is a favorite with many largegologists. Iodoform insight tion is recommended highly by the older largegologists. Orthoform and ancestless in or used for the relief of pain.

Freudenthal highly recommends integration for the cure of ulcerated areas. Argyrol (20 per cent) is an acceptable substitute when irritation follows the use of formalin lactic, intrice or hydrochloric acid. Intra laryngeal injections of gausseol (3½, per cent) menthol and comphor (as gr ii) in olite oil are often benchesal in the relief of pain and cough Deep injections of alcohol into the region of the increas may be used to allay pain. The u of the X ray is followed by admirence is rections.

When these measures are not sufficient to modify or allay the ravages of disease surgical intervention may be required. The lesions affecting tho epiglottis may be removed by epiglotte-tomy as practiced by Lochard of Denver.

Curettage has been employed to remove the tube reulous deposits. It is possible however to remove only a small portion of pathologic tissue by this method. It is advisable only in selected cases where other methods have fulled.

When deglithtion becomes very prunful a spray of cocain (10 per cent) before meals is justifiable. The Wolfenden position may be assumed with additional comfort in swillowing. The held is hing over the bed and the liquid drawn through a tube from the glass upon the floor. In this manner the patient drawn hinks like a horse.

Larva_cotoms throtomy, or tracheotomy are rardy undicated in this disease. In the lite ubcrative stage it may be necessary to administer an occisional small dose of morphin larpodermically. Constitutional treat ment may be of advantage in the earlier stages, in the form of cod liver oil, malt, hypothosphites, or cressore

### CHAPTER III

### DISEASES OF THE BRONCHI

## ROBERT D RUDOLF

#### BRONCHITIS

## Acute Bronchitis

Acute extarth of the respiratory tract is usually a widespread iffection, involving more or less of the miscous membrine which extends from the upper air passages to the point where the bronchioles terminate in the air vesicles of the lung. The extarth may not stop here even, but may involve the air vesicles themselves, producing the common complication of capillary bronchitis—catarrhal passages.

Acute bronchitis is not a specific affection, but may be due to divers causes, and before attempting to take charge of a caso it is necessary to endeavor to find out the evact chological nature of it. Is it a primary infection of the respiratory nucosa, is it a local manifestation of some general infection such as measles or typhoid fover, or is the enturb secondary to a condition, such as mitral stenosis, congenital heart trouble, or some toxemia, such as gout, uremia, etc?

General Therapy—The amount of care necessary in a given case of esterril of the respiratory treet depends upon two things (a) the severity and extent of the inflammation (b) the general condition of the pittent. Thus as regards the first factor, the treatment of a cold in the head and a larvagitus is a very much less integent thing thru when the same extarrly reaches down to the bronchioles. Again, as regards the second factor, what would in a healthy adult be a view trifling attack of bronchists, requiring very simple treatment may in the case of a frail and aged person, be attended with the greatest risk to life, and must be combited in every possible wy. Many writers classify their cases of bronchits as regards the therapy into (1) entarth of the trichea and larger tubes, (2) caturth of the smaller bronch and bronchioles. The division is artificial, as the classes merge so gradually into one another hat, all though it is not done in this claster, the practitioner must use his discretion as to how much therapy a case requires.

Envronment —People with a tendency to acute bronchits should be curefully guarded against exposure to chills and to rapid changes of tem perature, such as the leving of a heated room for the colder ur outside Often it seems also that hot stuffy air itself is the cause of an attack, even if not followed by exposure to cold, and muny people have learned by butter experience to avoid crowded and heyted rooms on this account

It was noticed early in the late War that the Canadam troops remained well while under carvas during very bid winter weather on Salisbury Pluin, but very many suffered from bronchial eatarrh as soon as they were housed in buts

Patients, honever, should be evutously hardened against the evil effects of chill by free everties in the open air and by the everful use of cold baths and sponging followed by a rapid and vigorous rubbing with a coarse towe! Salt boths are here specially useful, the silt secuning have a stimuliting effect upon the skin, thus promoting a good reaction. To make a salt bath, rock salt should be added to the water to mike a 1 per cent solution. The strength may be inneressed to 5 per cent if the reaction from the weister bath be not sufficient. If a cold bath or sponging is doing good, it should be followed by such a reaction as to produce a sensation of glowing, if this does not occur, but instead the patient remains shirery, with grove skin and bluish extremities then the cold water should not be used, being replaced by a watern solution at short immersion in really cold water will often produce a better reaction than with a longer one in less chilly water. As a rule the hath should be between 65 and 76° F.

It often becomes necessary for people with a tendency to bronchitis to avoid the winter months in a cold climate altogedier. Where thus is possible they should select a place baying a warm and equable climate

The spring is usually the most trying time for such people, and one frequently sees the mistake made of their returning to their northern homes too soon, after a winter spent in the south, with a resulting attack of acute bronchitis. No sufferer from broachitis who has gone south for the winter should return until all problid danger of cold weather has passed. It is a good plun for them to come gradually north, stopping occasionally for a few days at intermediate places rather than to do the long journey in one stretch.

By thus avoiding the winter for one or two casons predisposed individuals may go through the trying cold season without an attack

Where for financial or other reasons at is out of the question for the individual to go south then it may be necessary for him to remain indoors during the cold months. This point will be further discussed under the headin, of Chronic Bronchitis.

Nothing predisposes so much to an uttack of acute bronchitis as a previously exiting chronic inflammation of the mineous membrane and bence a patient with this chronic condition should be specially looked after and giurded against any of the causes of an acute attack. When he goes into the cold air he should be cutioned to hreathe through the mose, and the weiging of a respirator is often aditiable, especially in the aged Where the upper air pissages are the seat of adenoids, cularged tonsils, or masal polypi, these almormalities should be attended to and if neces aary removed, as they cause mouth hreathing and, further, are apt to be the local cause of a catarrh, which may then become more widely spread. The usal pissages are the natural warmers of the inspired air (see Chronic Bronchitis).

An individual setually suffering from acute bronchial catarrh should be confined to bed, and he should remnin there is long as there is any fever. In such an environment he will get over the attack more speedly than he will otherwise do even if he stars in one room. Even where the extern's is limited to the upper air prisages, recovery will be more speedly if the patient takes to his bed for a div or the

The air of the room should be kept fresh by free ventilation, but should not be cold and the patient should be kept out of druights. Many modern clinicians believe that the temperature of the sed, room does not matter much so long as the air be pure, but in the writer's opinion, bronchitic cases should not be exposed to such cold amy with impunity and one benefit be allowed in cases of lobar positional my diminiary tubercu losis. Cold air acts as an irritant to the inflamed bronchial mucous mem brane apart from any danger of chilling of the surface of the body, and a bronchitic patient soon finds how a breath of cold air makes time cough

An atmosphere at a temperature of about 65° F 13 probably the best, and care should be taken that the room does not become much colder than this The greatest risk of this is in the early bours of the morning, when the furnice is apt to become low

A Turkish bath will sometimes cut short an acute bronchial catarrb if taken at the very beginning of the attack. Short of a Turkish bath, a thorough sweating, produced by the use of a hot air bath, may set in the same honeficial way. Folding cabinets for this purpose are obtainable and are often very efficacious. The patient is undressed and wrapped in a blanket and allowed to stay in the hot air bath for from ten to twenty minutes. While there he should have a cold wet towel round the head and should drink freely of lemonade or some alcoholic drink as directed. The Imperial Drink, made by dissolving a terspoonful of and turtrate of potash (purified cream of tattar) in a pinut of boiling water and then adding a slice of lemon peel and sugar to taste and taken cold, is useful here as a diaphoretic and diuretic, and is very refreshing to the fevered patient.

The Turkish bith or hot air bath should only be used where the patient can go at once to bed and if this be impossible it is best not to use

either at all Many an individual gets more harm than good from taking a Turkish bath and then going out in the cold soon after it

A morst, warm atmosphere has a soothing effect upon the influmed mucous surfaces, and in severe cases, it is well to surround the patient's bed with a tent into which steam is introduced

The steam may he had from a bronchitis kettle" made for the purpose, but one may be easily improve of hy attaching a cone of brown paper or thin cardboard to the spout of a kettle. The steam should not be directed toward the patient's face, but rather in the direction of the foot of the bed This is a practical point which is often neglected, with the result that the respiratory tract is irritated by a too hot vapor

The patient should be kept very quiet, the act of speaking often being sufficient to produce a fit of coughing. With this end in view it is often wise to exclude friends

In the dry arritable stage of the disease, especially when the larynx is involved in the catarrh the act of coughing tends to further irritate the mucous membrane and thus a vicious eircle is established. To tell the patient not to cough is often a counsel of perfection and vet by getting him so to endeavor, many unnecessary spells of coughing may be avoided and thus the inflamed parts are at least partially rested

In severe cases the calls of nature must be attended to in bed and in all cales the patient should be specially protected from chills when attend

ing to these needs

Every sufferer from bronchitis has some dyspnea and this may be so marked that he may require to be propped up in bed. As he improves this propping up will be less needed, and the fact that to-day he can do with a pillow less than vesterday is one of the most certain signs of improvement

In severe cases the patient should not be left in one position too long and the nurse must be instructed to shift him from side to side at frequent intervals in order to lessen the chances of circulatory and bronchial

stasis in any one part of the chest

William Ewart emphasized the value of mechanically aiding expiration in cases of acute bronchitis complicating emply emp. The expiration which should normally be a passive act, becomes as a result of the loss of elasticity of the lungs, an active one, and hence tends to tire the patient The trained nurse or the physician, should place the hands over the axillary bases of the lungs and exert carefully timed pressure here synchronously with expiration The effect is to tend to eject some of the secretion further up the respiratory tract whence it may be more easily coughed up The method is specially valuable and necessary in the aged and feeble It should be repeated for a few minutes several times in the twenty four hours

Diet —Prinents suffering from weste bronchitis have fever, and on general principles their diet should be light and digestible, as here, as in all cases of fever, the digestive powers are more or less limited. Milk should be the steple food, and, in addition, milk puddings, gruel, jellies, sonns, and other helpt thines may be added.

Warm nucleginous or slightly alkaline drunks are comforting to the patient, and in the early and dry stige of the cut irrh act as expectorants, diminishing the teneuty of the spatim and in this way aiding the cough Burley water, lin eed tea, thin gruel, and oatmeal water are all useful here and sold or potash water with mulk is an excellent drink.

The addition of some whisky, cogare, or rimi to unch drinks at bed time in many cases, especially with aged patients, secures a better night's rest

Although a largely fluid duet is generally advisable in acute broughtts, it may occasionally be wile to allow adult patients, who happen to dislike fluids, to have more solid articles, such as lightly boiled eggs, puddings, with bread and butter

In the slighter cases of acute brenchial catarrh a bot bath, a hot bed, a hot drink of grad and whisky, with 10 gr of Dovers powder at bed time, may be sufficient to brune him back to the normal by next day

If there be any constipution it is well, at the leginning of the attack to give a mercural purgitive such as cilomel or blue pill, followed in either case by some subjue next incoming

Specific Treatment—Bronehitts is not due to any one infection as a rule and it is usually beyond our powers to attack it by any specific therapy. Within recent years various vocanes have been used, but these base obsely been employed in the more chronic and persistent forms of the disease (see Chronic Bronchits).

Camphor — Many people think, and probably with some reason, that they can cut short or lessen a respiratory cutrir by the evily and free use of camphor internally One or (0066 gm) may be given every two hours or so, either by itself in pill or cupsule form, or it may be combined with other ingredients. A nseful prescription is one suggested by Dr Arthir Newlin, as follows.

| Codemæ sulphutis | gr 1/16 | 0 004 gm | Camphoræ monohromatæ | gr 1/2 | 0 030 gm | Aspirin | gr v | 0 300 gm | Misce et flat capsula

Sig One capsule to be taken every three hours

Quinin —Quinin is much used by the luty for checking a entirchal fever, and seems to have some good effect. A useful prescription in fever ish cold is as follows:

$\mathbf{B}$	Quininæ sulphatia	gr	1	0 06 gn	a
	Phenacetini	gr	11	0 15 gr	a
	Sodii salicylatis	gr	111	0°0 gr	Ω
	Musce et fiat cansula				

Sig Take one capsule every four hours

It is often a good plan to give two of these capsules for the first dose and then follow with one every four hours

Symptomatic Therapy -The natural tendency of an acute respiratory catarrh is to disappear and, in most cases, as afreidy said, if the patient be kept warm and at rest, the disease will more or less rapidly go through its phases of congestion secretion and final drying up of this, and will leave the mucous membrane none the worse for the invasion In coryza, where inflammation of a mucous membrano may be watched and di rectly studied, the first stage is seen to be one of engorgement the mem brane being swollen and reddened, so that more or less complete obstruction of the nasal passages occurs Next follows the stage when there is free secretion of a watery exudate which is accompanied by great relief of the engorgement and consequent case to the sufferer. In the third stage the secretion become scaptier and mucopurulent and then gradu ally dries up and disappears In catarrh occurring further down in the respiratory tract very much the same stages are gone through. As a result the patient first has a dry and irritable cough with some dyspnea due to obstruction from the swelling of the mucous membrane There is usually also substernal discomfort and even pain from the same cause Next, as the secretion becomes established, the cough grows freer and productive of a thin and often frothy expectoration. Finally this secretion becomes thicker and scantier and then disappears

Much may be done by appropriate treatment to lesson the patient's discomfort as he passes through these stages and, by a proper medicinal and other therapy we are often able to hasten his return to the normal, and even to bring this about when otherwice it might not occur

At the onset of every scute respiratory catarrh, as already mentioned, it is a wise plan to give a purgative A useful one is the following

B. Pılulæ hydrargyrı

Piluke colocynthidis et hyoscyami aa gr ii to v (0 1 o 0 35 gm) Misce fiat pilula

Sig One at bedtime followed by a Seidlitz powder in the morning

# Or the following

I) Pilula hıdrargyri
Extracti colocy ilindi composita
Pilula riba (composita a gr 1½ 0 10 gm
Extracti hıosexamı
Musec fat pilula

ig One at bedtime followed by a salue next morning

Diet —Patients suffering from acute bronchitis have faver, and on general principles their diet should be light and digestible, as here, as in all cases of fever, the digestive powers are more or less limited. Milk should be the staple food, and, in addition, milk puddings, gruel, jellies, souns and other light things may be added

Warm muciliginous or slightly all lime drinks are comforting to the patient, and in the early and dry stage of the eatherh act as expectorants, diminishing the tenacity of the sputum and in this way aiding the cough Bariley water, linseed tea thin gruel, and outmeal water are all useful here and soil or potash water with milk is an excellent drink.

The addition of some whisky, cognae or rum to such drinks at bed time in many cases, especially with aged patients, secures a better night's rest

Although a largely fluid diet is generally advisable in aente bronchitis, it may occasionally be wise to allow adult patients, who happen to dislike fluids, to have more solid articles, such as lightly boiled eggs, puddings, with bread and butter

In the slighter cases of acute bronchial entarth a hot bath, a hot bed, a bot drink of gruel and whisky with 10 gr of Dovers powder at bed time, may be sufficient to bring him back to the normal by nort day.

If there be any constipation it is well, at the beginning of the attack to give a mercurial purgative such as calonicl or blue pull, followed in either case by some solution next morning.

Specific Treatment—Bronchius is not due to any one infection as a rule, and it is usually beyond our powers to attack it by any specific therapy. Within recent verus various vaceines have been used, but these have chiefly been employed in the more chronic and persistent forms of the disease, (see Chronic Bronchius).

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| Codence sulphates | gr | 1/16 | 0 004 gm | Camphore monobromate | gr | 1/2 | 0 030 gm | Aspirin | gr | v | 0 300 gm |

Misce et fiat capsula Sig One capsule to be taken every three hours

Quanta—Quanta is much u ed by the Luty for checking a catarrhal fever, and seems to have some good effect A useful prescription in fever ish cold is as follows

В	Quininæ sulphatis	gr	1	0 06 gm
	Phenacetini	gr	11	015 gm
	Sodn salicylatis	gr	m	0 20 gm
	Misce et fiat capsula.			

Sig Take one cap ule every four hours

It is often a good plan to give two of these capsules for the first dose and then follow with one every four hours

Symptomatic Therapy -The natural tendency of an acute resultatory catarrh is to disappear, and, in most cales as already said if the patient be kept warm and at rest, the disease will more or less rapidly go through its phases of congestion, secretion and final drying up of this, and will leave the mucous membrane none the worse for the invasion In coryzi, where inflummation of a mucous membrane may be watched and di rectly studied, the first stage is seen to be one of engorgement, the mem brane being swollen and reddened, so that more or less complete obstruction of the nasal passages occurs Next follows the stage when there is free secretion of a watery exudate, which is accompanied by great relief of the engorgement and consequent ease to the sufferer. In the third stage the secretion become scanticr and mucopurulent, and then gradu ally dries up and disappears. In catarrh occurring further down in the respiratory truct very much the same stages are gone through. As a result the patient first has a dry and irritable count, with some dyspnea due to obstruction from the swelling of the mucous membrane There is usually also substernal discomfort and even pain from the same cause Next, as the secretion becomes established, the cough grows freer and productive of a thin and often frotby expectoration. Finally this secretion becomes thicker and scantier and then disappears

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Pılulæ hydrargyrı Pılulæ colocynthidis

Pilulæ colocynthidis et hyoseyamı aa gr 11 to v (0 1., 0 35 gm )
Mi ce fiat pilola

Sig One at bedtime followed by a Seidlitz powder in the morning

# Or the following

B Pilulæ hvdrargyri

Extracti colocynthidi compositi Pilulu rhi i compositie aa gr 1½

Pilula rh i compositæ aa gr 1½ 0 10 gm Extracti hyoseyama gr ½ 0 03 gm Misce fiat pilula

Sig One at bedtime followed by a saline next morning

Or the patient may be given 1/2 to 2 gr (003 to 012 gm) of calomel at bedtime, with a saline next morning

Local Treatment—Lunsced Poultices—In the early stage of acute honchits the application of Innseed poultices to the chest gives relief The poultices must be light, and as hot as cun be borne, and, if properly made, are a great comfort to the putient But a bidly made, perhaps lumpy, heavy, and hilf cold poultice is worse than useless, and if we cannot be sure of having them well made we had better do without them

Poultices should be renewed every two hours It is often a good plan to put one on for two hours, then replace it by a cotton wool jacket for

two hours, then a poultice again for two hours, and so on

Mustard Poultices—A mustard poultice over the upper sternal region is often useful. It may be left on for the to twenty minutes, and upon removing it the skin will be found to be reddened, and should then be smeared with viselin. On no account should the poultice be left on indefinitely, or, as one sometimes here for "as long as the patient can stand it," for after some minutes the oil of mustard acts as an anesthetic and, without much discomfort to the patient, a severe burn may be in flieted. Slight burns from this cause are commonly seen, but very severe ones may occur, as in a case seen by the writer, where an infant was so badly burned that it died, and at the postmortem it was found that the ribs and sternium were included in a deep slough

Mustard Leaves — "Mustard leaves" are used in the same way, left

on for the same time. They are less severe than the poultice

Turpentine—Turpentine is a favorite external application in acute bronehitis. It may be sprinkled upon a cloth, which is then applied for ten to twentry minutes or it can be used in the form of a turpentine stupe which is a hot fomentation with a terspoonful of turpentine sprinkled over it. The stupes should be renewed every four hours, and after the first one or two the turpentine is best omitted.

Stimulating Liminents—In the slighter cases of acute catarrh, and in most cases later on stimulating liminents are valuable. They are usually rubbed over the whole chest night and morning and, by keeping

the 1 in reddened, seem to relieve the deep congestion

Turpentine is the drug most commonly used for this purpose, either in the form of the linimentum terebuiltume or, if this be not strong enough to redden the shin, then as the linimentum terebuiltume acticum (B P) Tho latter is an imitation of the celebrated St John Long's Liniment. A useful addition to the ordinary turpentine liniment is the one suggested by Kingston Fowler, which consists in the adding of a drachm of the tincture of iodin to each ounce of the liniment. In severe cases, where the dispine as marked dry, or even wet, cupping over the roots of the lungs in front and behind is a useful measure

Leeches -The application of six or eight leeches over the roots of

the lungs is often valuable in such cases. Where leeches are used it must, of course, be seen that the bites have stopped bleeding before the patient is left, as neglected leech bites may bleed very severly. The bleeding is easily stopped, as a rule by the application of powdered alum over which pressure is applied by means of tightly rolled absorbent cotton kept on with stripping. Dry or net capping of the chest is often useful. It is a remedy much used in France.

Cold—Some practitioners prefer to apply cold rather than heat to the chest in acute bronchitis. An ice-hag may be used and it is necessary to see that this is only partially filled with inely broken ice, and that all the air is excluded before the bag is closed. If these small details be not attended to the hag does not the confortably on the chest, or indeed on any part of the bods. Or cold may be applied in the form of a cold compress. Such compresses should be changed rather frequently, say every fifteen or thirty minutes but even if left on for several hours seem to they reflect as along indeed, as any misoture remuins in them.

The Priesantz compress, so highly recommended by Ortner of Vienna, consists of a cloth wrung, out of water at room temperature with a hot cloth bound over it. As soom as the inside compress is dry it should be renewed and after it is finally removed the cheet should be thoroughly rubbed, cometimes after it has been first sponged with cold water. As Ortner says, the action of this compress is not exactly understood, but it amoents to be somewhat is follows.

The cold application at first causes in active contraction of the cutaneous ressels. As soon as the cold bandige is warmed by the application of the bot one over it, this contraction gives place to active dilatation combined with a sustained tone of the vessels which persists for some time and causes an active hypercmia of the skin. By the initial application of cold the nervous centers are reflexly stimulated the breathing is momentarily deepened and the nervous tone of the vessels is increased By the alternate action of the heat and cold the innervation of the internal organs is stimulated reflexly and the secretion of the diseased bronchild mucous membrine and the circulation in the lungs are fivor ably affected.

In some cases, owing to the low tone of the patient, the cold compress remains cold even after it is covered by the hot bandage, and the patient experiences an unpleasant feeling of chilliness until it is removed. In this case it is well to use, instead of the outer flannel, a preced of old all for rubber tissue. This will probably precent the feeling of chilliness

Vapors —There are muny means by which applications are directly made to the inflamed mucous surface. The most common one perhaps is the inhalation of vapor from hot water either alone or impregnated with some medicinal agent. As already stated when it is thought necessary to use a steam kettle, the spont, or cone connected with the spont

should not be directed toward the patient's face, but rather toward his feet, when the patient is in bed with a test over it **Compound tincture of benzoin**—Frina's Balsum—is commonly added to the water in the kettle, a teaspoonful or so being put in, and as a result the vapor becomes loaded with the volatile ingredients of the prepriation. In slighter cases vapor may be inhaled from a jug over which a folded towal is so placed as to direct the vapor toward the face. The water in the jug should not be at boiling point, but it a temperature of about 150° F. This tem perature may be roughly attained by mixing equal parts of boiling and of tap water. On the surface of the water may be thrown Frint's Balsam or any other medicament which it is desired to use. Such most inhals tions have a very soothing effect, and may be repeated with advantage every hour or so, each period of inhal-tion listing for about five minutes A pleisant preparation to be used in this manner is one recommended by P. Clusson, as follows:

Ŗ	Menthol	gr ı	0 060 gm
	Tincture benzoini	mın v	0 600 cc
	Olei eucalypti	min v	0 350 се
	Alcoholis (90 p c)	nd dr i	4 000 cc

Misce firt mixtura
Sig This amount to be placed in a little hot water and inhaled for five

Sprays—Sprays are often valuable in acute respiratory catarrh, especially when inflammation involves the traches and mucous membrane bigher up than the bronch. Sciler's solution may be used here, or a spray containing the following sodium herrbonate, 10 gr (0 600 gm), glycerin of carbohe acid, 1 dram (4 0 cc), in an ounce (30 0 cc) of rose water. There are a great variety of such sprays used by the profession the chief points of similarity between them heing that they are alkaline and contain some romatic antisoptic. Such sprays should be used warm and should be frequently repeated

In the later stages of acute catarrh the inhalation of eucalyptus appears to lessen the secretion and give comfort to the puttent. He may inhale the pure oil from a handlerchief or from a Burney Yeo zinc inhaler. A valuable mixture to be thus used is the following.

 Ry
 Menthol
 1 part

 Eucalypiol
 2 parts

 Benzoinol
 3 parts

 Misce et fiat inistura

 Sig
 Inhale frequently

An even more soothing inhilant contains equal parts of menthol, eucalyptol terebene and chloroform

Turpentine may be inheled in the same way, and is often useful in the later stages of a catarrh. It is too irritating for some patients and may then be advantageously combined with equal parts of spirit chloroform.

Internal Medication—Laxalites —As already stated it is well to begin the treatment of a case of acute bronchitis with a laxative

Many drugs are used with the objects of lessening the fever and modifying the bronchial secretion

As regards the latter indication the bodies chiefly used in the early stages of the disease belong to the class of so-called soothing or nauseat ing expectorants of which class specieusnha, antimony, and various alka his are the chief members

Expectorants — The whole subject of the use of expectorants is at pre ent in a state of chaos. From a phirmacological point of view many of the drugs which clinicians have found to be of most value are without expectorant effect while, on the other band, others which are most effective according to theoratory experimental evidence do not find favor with the prictitioner. Probably a reason why these differences of opinion exist is that the two classes of observers are de lung with different tissues, the clinician nising diseased subjects for his work, while the pharmacologist does most of his experiment upon normal animals or people. A diseased microus membrane may react quite differently to a normal one. Moreover, the reports of different pharmacologists upon the expectionant action of the amed rings differ widely in many evises so much depends upon the way in which the experiments are done the dose used, the hind of animal employed the aneither given etc.

It must for the present be admitted that the employment of drugs in the treatment of bronchial affections is more of an art than a science. No doubt the tendency has been in the past to use expectorant mixtures with too free a hand but they have their place, and, when skilfully employed undoubtedly decrease the discomfort of the patient and listen recovery.

F Forchheimer expressed the opinion of most thinking clinicians when he said 'Experiment has taught me that the expectorants are unreliable but I should not like to be without them"

In a mild case of acute bronchitis the following mixture will promote the patient's comfort and hasten the onset of free secretion

Ŗ

Vini ipecacuanhæ			
Pota an acetatis	aa dr 1	aa 400	gm
Spiritus witheris mitrosi	dr n	8 00	сc
Syrupi toLitani	oz 1/	15 00	сe
Liquoris ammonii acutatis	ad oz m	100 00	сe
Misce firt mi tura			

Sig A des ert poonful in water every four hours

If the cough be very irritting a little opium may be added to each dosefor example, 10 drops of the camphorated functure of opium (paregorie)

Antimony acts powerfully as a depressing expectorant. It is usually given as the wine of antimony, and quite small does frequently repeated are useful, and in furly strong patients, are free from depressing effects

B	Vini antimonii		4 00 to 8 00 cc
	Liquoris morphine hydr		
	chloridi	dr 1/2	200 cc
	Liquoris ammonii acetat	15 07 11	60 00 ec
	Syrupi tolutani	07 1/2	15 00 cc
	Aquæ chloroformi	ad oz vı	ad 200 00 cc
	Misce fiat mistura		

Sig A tablespoonful every four hours

In stheme individuals with high fever accente is often used. It is best given in small, frequently repeated doses, thus I drop of the time time (B F) is given overy fifteen minutes until the skin becomes most and the pulse slower. Then this may be replaced by a mixture containing pecaculanha or antimony, such as one of the above. It should be noted that the American inecture of aconic is double the strength of the British It is well to remember that preparations of account quickly deterorist and even with good preparations the effect is very uncertain. The action of aconite however, is very slight and the writer found that even much larger doses than pharmacoperal ones failed to affect the pulso rate or blood pressure.

Apomorphin is used as a depressing expectorant in the early stage

Misce fiat mistura Sig A table-poonful every two to four hours

Pilocarpin is used a good deal in Germany for increasing the flow of bronchial secretion in early cases. It should be given in doses of 1/20 to 1/10 gr (0.003 to 0.006 gm) three duly in the form of the intrate by mouth, or hypodermically in rather smaller doses

The use of optim or its preparations in acute bronchitis requires great care and discrimination. When used in the dry and irritable stage of the disease, in small doses, it is often of the greatest value in easing the wearing and useless cough, but it should never be given in cases attended with a profuse secretion, and in suffocative ones. In such patients we dare not

lessen the sensitiveness of the mucous membrane and thus reduce the cough upon which the patient's very lite may depend

В,	Extracti opu	gr ½	
	Extracti stramonn	gr 1/4	0 010 gm.
	Misce fiat pilula		
Sig	One every two hours		

Codem is often a useful drug where an opium preparation is indicated as it disturbs the alimentary functions less than does opium or morphin. It goes well with incacuanha wine and spirit of chloroform

В	Codemæ pho phatis	gr	٧ı	0 400	gm
′	Vini ipecacuanhæ	dr	11	8 000	e c
	Spiritus chloroformi	đr	u	8 000	С¢
	Aquae	ad oz	31L	100 000	еc

M1 ce fiat mistura Sig A teaspoonful every four hours

Such a prescription would be appropriate in the early and dry stage of the acute disease

Heroin hydrochlorid (diacety) morphin hydrochlorid) is an artificial alkaloid prepared from morphin, and has been advocated as a substitute for morphin in respiratory conditions. It may be given in doses of 1/24 to 1/16 gr (0 002 to 0 004 gm) either by the mouth or hypodermically ⁴

Soprifice—Sleeplessness is often a marked feature in acute brought in and may require to be specially met Opium abould never be given in such a case to obtain a good night's rest Verona's in doses of 5 to 7 gr (0 300 to 400 gm). Sulphona's in doses of 15 to 30 gr (1 00 to 1 30 gm), or parallelnyd in doses of 3½ to 1 dr (2 00 to 400 c.c.) are preferable. The last named drug is very valurble as a non depressing hyporton. It has a most objectionable taste and odor but may be fairly easily given is a mixture flavored with syrup and liconce or else in capsules. It may also be given by the bowl.

Chlorul hydrate is often useful in the sleeplessness of acute bronchits but its effects must be closely watched, when it is decided to use it. It is perhaps best to give a small dose, which may be represted once or twice during the night at the discretion of the attendant. The drug is rapidly excreted and thus will not accumulate in the system. The syrup (B.P.) contains 10 gr of the drug in each drain which is an average dose.

Other useful and comparatively harmless hypnotics are chloralamid

The widespread use of herom by druw habitude has led to its abandonment in some state institutions as a component of cough nortures. While its value is not denied it would seem that the dam-gres incident to its use are so great that other substances almost equally effect at and its damperous alouable relied upon —Editor

which produces chloral by its decomposition in the body, and his less effect upon the circultion than has that powerful dru,, trional and lastly bromural Chloralamid is given in doses of 15 to 45 gr in eachet, or dissolved in a weak spirituous or acidulated solution, trional, in 10 to 20 gr powders or in cachets, and bromural, probably the mildest of all of those mentioned, in doss of 10 to 15 gr.

If hypnotics require to be used for some time, it is wise to vary them, and as a rule not to give them oftener than every second or third night

When, in acute bronebitis, the secretion is well established, expectorants are not much required but many use here, with apparent benefit to their patients, the so-called stimulating expectorants. These give relief and appear to make the expectoration come away with more case and then dry up rapidly and disappear.

Stimulating Expectorants — The stimulating expectorants most commonly used are squills senega and ammonium carbonate. For example

В			
	Ammonii carbonati	1/2 dr	200 gm
	Tincturæ scillæ	3 dr	12 00 cc
	Syrupi tolutani	1/2 02	15 00 cc
	Infusi enegæ	3 oz	90 00 cc
	Aquæ chloroform	ad 6 ez	200 00 cc

M1 ce flat m1-tura Sig A tablespoonful every four hours

If the cough be troublesome, a little opium may be added to this mix ture, but as alrada said, this must be done with great caution, if at all when the secretion is very free.

Belladonna —In severe eases of bronchitis, where the dyspined is marked and there appears to be extensive involvement of the bronchioles, belladonna is viduable, in that it lessens the secretion and at the same time stimulates the respiratory center. The same is true when the bronchitis is complicated by preumonia, and in such cases it is well to push the belladonna until the pupils dilate and the month becomes dry and the skin flushed. In the bronchopicumonia of children this treatment seems to he of special value. When whereing is a marked feature of a bronchial attack belladonna is useful in relicing this asthmatic tendency.

Sydney Ringer and William Murrell have both very strongly recommended the use of belladonna in the secreting stage of acute bronchitis, and the writer has frequently seen the great value of it here N T Davies, of Sherborne speaks of its 'magic effects' when used in acute bronchitis, and, indeed in asthuri itse, as an inhalation. He recommends I gr (0.05. gm) of the extrict of belladonna dissolved in half an ounce (16 cc) of warm water in a Dr Siegel's inhaler. The writer has no experience with this method, but it should be valuable, as

drugs are very rapidly absorbed from the respiratory tract, and one would get both the local and also the general effects of the atropin

Lobelia.—The ethereal functure of lobelia is also much used here, in doses of about 10 drops. Its action resembles that of balladonna

Measures for Relief of Cyanosis-Cupping -- When any evanosis exists the likelihood is that the right heart is overstrained and tending to give way and remedies must be used for its relief Dry cupping over the sternam and scalpula is valuable here. It is indeed a remedy the good influence of which has been independently discovered by most rices the world over. Where the distress is very severe uet cupping may be em ployed A scarnier is convenient, but by no me ins necessary, for this as a few preliminary shallow incisions with a sharp scalpel are ill that is required A Bier cup is specially useful where wet cupping is to be done as the suction may be regulated in a way that is not possible where the vacuum is obtained by burnin, spirit I few lecches over the roots of the lungs let in much the same way. If these milder methods of relieving the cyanosis be not sufficient then bleeding from a vein in the arm or even from the external jugular vein may be practiced with great relief. The removal of 5 to 15 ounces of blood is usually sufficient. In very severe cases the blood may not flow from the opened your and it may be then assisted by gentle aspiration with a syringe

Strychnin —In these di tressing ea es hypodermies of strychnin are of great value and 1/20 gr (0 002 gm) may be given every three or four hours with advintage. This dose may be doubled in evere cases

Inhalation of Oxygen—The value of this measure is very differently gaged by different observers but undoubtedly it has some action in its sening cyanosis and in the writer's opinion should never be neglected in severe cases where this lividity is marked. Orther says here

In cases of dispines evanous, marked diminition of the respiratory surface and coincident weakness of the heart the above mentioned hydropathic measures may be supplemented by the inhaltition of oxygen. If 20 gallons at least are inhald daily good results often appear although we may not be able to explain them theoretically. The breathing and heart action are slowed, and the subjective symptoms are much improved, showing that owing to the inhalation of oxygen, more oxygen has payed into the blood and tissues.

The method by which ovegen is given is all important. If the gas be merely administered through a funnal held near the face of the patient luttle good results. An excellent though wasteful way is to give it through a rubber tube placed in one nostral. If this tube in the no e cau es distress it may be put in the month. Still better is the Veltzer inhaler. An ovegan chamber is the best of all but naturally can only be employed in large institutions. In severe bronchutis and in bronchopneumonia the

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which produces chloral by its decomposition in the body, and has less effect upon the circultant than has that powerful drug, trional and lastly bromutal. Chloralamid is given in doses of 15 to 45 gr in eachet, or dissolved in a weak spirituous or redulated solution, trional, in 10 to 20 gr powders or in eachets, and bromutal, probably the mildest of all of those mentioned in doses of 10 to 15 gr.

If hypnotics require to be used for some time, it is wise to vary them, and as a rule not to give them oftener than every second or third night

When, in acute bronchitis, the secretion is well established, expectorants are not much required but mans use here, with apparent benefit to their patients, the so called stimulating expectorants. These give relief and appear to make the expectoration come away with more case and then dry up randly and disappear.

Stimulating Expectorants —The stimulating expectorants most commonly used are saudly senega and ammonium carbonate. For example

Ammonii carbonati«	1/2 dr	2 00 gm
Tincturæ scillæ	3 dr	1º 00 cc
Syrupi tolutani	1/ oz	15 00 cc
Infusi senegre	3 cz	90 00 cc
Aqua chloroformi	ad 6 oz	200 00 cc

Misce fiat mistura Sig A tablespoonful every four hours

If the cough be troublesome, a little opium may be added to this mix ture but, as already said, this must be done with great caution, if at all, when the secretion is very free

Belladonna—In severe cases of bronchits where the dysmon is murked and there appears to be extensive involvement of the bronchioles, belladonna is valuable in that it lessens the secretion and at the same time stimulates the respiratory center. The same is true when the bronchits is complicated by pneumonit, and in such cases it is well to push the belladonna until the pupils dilate and the mouth becomes dry and the skin flushed. In the bronchopneumonit of children this treatment seems to be of special value. When whereing is a marked feature of a bronchial attack belladonna is useful in releving this submarte tendency.

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Ammonii earbonatia	1/2 dr	2 00 gm
Tincture scille	3 dr	12 00 ce
Syrupi tolutani	1/ oz	15 00 cc
Infusi penega	3 oz	90 00 cc
Aquæ chloroformi	ad G oz	200 00 cc

Misce firt mistura
Sig A tablespoonful every four hours

If the cough be troublesome, a little opinm may be added to this mix ture, but, as already said, this most be done with great caution, if at all, when the secretion is very free

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When the acuteness of an attack of bronchits has passed away and the ferer is more or less gone, occasionally the cough remains trying and the sputim thick and difficult to get rid of In such cases polarium todid in small does thrice daily is valuable

Ammonium chlored is also here much used The dose is 5 to 20 gr (0 3 to 1 3 gm), and the unpleasant taste may be partially covered with the liquid extract of heorice, or it may be given in a mixture somewhat as suggested in Sourie's Companion to the British Pharmacopena

Ŗ	Ammonu chloridi	dr 1	a 800 g	m
	Syrupi limonis	oz 1	15 00 e	¢
	Spiritus chloroformi	dr	1 400 c	c
	Aquæ	ad oz	<b>v1</b> 200 00 c	c

Musce fiat mistura
Sig A tablespoonful every two to four hours

Lozenges containing 2 gr (0 3 gm) of the drug, are useful Potassium bichromate has been recommended by E G Paxton

Polysium bichromate has been recommended by E G Paxton and others at this strge of the disease where the eputum is thick and tenacious and hard to bring up

The usual dose is 1/64 gr (0 001 gm.) every hour or two

On the other hand in some cases late in the disease, the sputum remains or becomes very profine. Here the mineral acids especially the intro hidrechiora end in doses of 6 to 20 minums (0 3 to 1 3 c c) appear in some obscure way to lessen this excess. Wost bospitals have an acid expectorant mixture for this purpose, such as the one at 5t. Bartholomews which is as follows.

B,	Acidi nitrohydrochlorici diluti	min	x	0 60
	Tincturæ aurautu	min	XX	1 25
	Aquæ chloroformi	ad oz	1	30 00
	Misce fist mistura			

Sig Thrice daily after meals

With it may be combined 5 to 10 drops of tincture of nux ionica. After the fever and all acuteness have subsided the patient should be out of bed and in the open, a change of air especially to the sessaide is now of value. He will probably require some tonic, most commonly cod liver oil or rion or the two combined

#### CHRONIC BRONCHITIS

Chronic bronchitis is a very common disease and exists in all degrees—from a slight tendency to catarrh to one so severe that it and its complications frequently prove fital arternal blood is undersaturated with oxygen and this undersaturation can be largely removed by an efficient inhalation of the gas

The idea naturally occurs that in desperate cases oxygen gas might be administered directly into the tissues, and several writers have urged the value of this method Recently Dr. Sacquepte, professor at the Val de Grace, read an interesting paper before the Societe de Medecine Militaire Française on the use of oxigen in this way in acute respiratory conditions The treatment is purely symptomatic, but rapid relief of the distressed breathing is seen, the heart beats are slowed and the blood pressure rises Rapin mentions a case where a child of fourteen months was apparently in articulo mortis from diffuse bronchitis of both lungs. The child was unconscious, cold cyanosed and the pulso was imperceptible Virious remedies were tried without effect including the inhalation of oxygen Then this gas was injected under the skin of the thigh. The immediate effect was to raise the temperature locally, and the lividity of the skin here was replaced by a rosy color The dispues became relieved and the pulse perceptible The treatment was cautiously continued, first in one thigh and then in the other and the patient recovered Experiments on rabbits gave the following results (1) An animal which has received a prophy lactic injection of oxygen under the skin resists asphyria longer than does a rabbit not so prepared (2) Existing asphyxia can be relieved by the hypodermic introduction of oxygen, and the pulse simultaneously im proves (3) If asplaying is pushed until the corneal reflex is abolished, the injection of oxygen permits of recovery, even though the duration of apnea has been prolonged beyond the period fatal in control animals. The method would probably prove of service in any condition characterized by evanosis and applyxin. The apparatus is simple. A rubber tube is connected by a stopcock with a gas bag full of oxygen. The other end of the tube is lightly plugged with sterile cotton wool, and then connected with a large bore hypodermic needle In France where the method has been much used lately Martinet's oxygenator is usually employed

used lately Martinet's evergenator is usually employed.

Emetics—Occasionally, when the bonochual secretion is ever-sive and
the power of coughing it up is insufficient, an emetic is valuable and even
his saving. Emetics are chiefly given to children, they should be used
with caution where the pulse is weak. Anv sign of pulmonary collapse,
however, is an urgent indication for such therapy in strong pitients. For
an adult 20 gr (1.36 gm) of powdered specuaruha or half an ounce of
the wine will usually be sufficient. Mustard and water is a useful and
relatively non depressing emetic, and should be given in the strength of a
tablespoonful of mustard dissolved in a tumbler of warm water. Apomorphin hypodermically administered is very certain in its effects, but
gives rise to a good deal of depression and hence should be used with
caution. The hypodermic dose for the production of cmess is 1.290 to
1/10 gr (0.003 to 0.006 gm), and it usually acts within five minutes.

place in which the patient can be the greatest number of hours in the open air, especially when this is combined with sinlight

In the summer months a bracing climate will generally be found to be the best. The prairies of the northwest ofter a beautiful ruland climate and the seacosis on both sides of the northern part of the continent reexcellent where sea air is preferred. Muskoka the Georgian Bay and the Thousand Jalands are very frontle lake and woodland resorts. In all of them the pure air and absence of dust air marked.

The great majority of patients either ure not all enough to make it expected for them to go away for the whole winter or, even if they are cannot afford the time or the money to do so. In the slighter cases it is sufficient to impress upon them the necessity of avoiding night are and amp windy weather but the more scriously afforted ones who reside in a northern country often find that they can only have comparative ease by deliberately staring indoors for some months. In elderly people this is not much of a hardship

O'use of chronic bronchial catarrh soon find out for themselves the evil influence of 'catchin, cold' Often however, in undervoiring to avoid this thoy defeat their end by making themselves to sensitive to chinge of temperature. Such people are the better for a process of hardening' the German Ibharlung). This is best accomplished by the daily use of the cold sponge douche or plunge and silt water seems to be specially serviceable here. Rock salt may be added to the water to make a 1 to 3 per caut solution. See water continus about a quarter of a pound to solids to the gallon and may be imitated very closely by adding common salt, 7 pounds magnessium chloroid, 1 pound, magnesium sulphute ½ pound to 30 gallons of water.

According to I II hellogg cuttaneous stimulation will be increased by the addition of half to one pound of chlorid of calcium to the bith The mistake must not be mide of employing the substrace commonly known as chlorid of lime the proper chemical name for which is 'cilcium hypothiotic Some such as Ortner recommend a 5 per cent solution of salt, and certainly this is useful if the hidropathy be limited to sponging. The salt more certainly hrings shout a reaction than does the mere cold. By such cold applications the skin is trunced to resist changes in the external temperature. Turkish biths are often useful, especially during any exactristion. The pritorit however must take great ever not to become chilled afterwards, and should quickly be got into a well warmed bed

In the same way patients may be hardened to breathe cold air but should be writted against month hreathin. The meal passages are specially adapted for warming the inspired air, we also for removing larger forcign bodies which have been include R. Hitchison remaineds us that air cottering the nose at freezing point is warmed to a temperature of

### The indications for treatment are

- 1 To remove as fir as possible, the cause of the primary condition and of the intercurrent exacerbations
  - 2 To ruse the patient's general health in every possible way
    - 3 To use means to regulate the amount of the expectoration
- 4. To relieve all nancees are concli, which cough not only tends to keep up the catarril but also mere uses the couplingers, may dilate the brough, and further tends to were out the patient by cansing sleepless nights and disturbed days.

Environment - 1 pitient suffering from element bronchitis should be guarded from inclement weather. The epitients are nearly always better and, judged often apparently well in summer, and it is frequently a good plan to advise that they af possible, spend one or two winters in the south By so doing and thus avoiding the neute exacerbations, which are so apt to occur in winter, they may completely recover and in time once more face a northern climate with impunity. The same winter resort will not suit every case. Generally speaking if the case be one in which the expectorition is scints and the cough hirissing, a mild and himid atmos phere will be indicated, such as is found in Florida, Nassan Bermida, and the West Indies, on this side of the continent, and near the coast of southern California on the west If, on the other hand the expectoration be profuse, a dry mr is indicated, such as is found in the inland parts of sonthern California Colorado, Texas Mexico and Egypt When a pa tient has gone South for the winter it is most important that he does not return to his northern home too soon in the spring. One often sees this error committed with the direct results

Witering places are much used, especially abroad in the treatment of chronic bronchitis, and often they are valuable. One might go into great detail as to the exact composition of this or that special water, but probably, as F. A. Hoffmann, of I capag, says, "the numeral springs them elves are prictically all of eightly value. They such human nature best, far better thin pure witer and a small amount of sulphur in the water makes a plei aut indused in change. If the stronger purgatives are pre-ent, their action, of course, becomes unportant for corpolately then the and those hiving a tendency to constitution und hemorrhoids. Of course it is not a matter of indifference where we send patients but the water itself makes little difference the situation, the presence of forests, the friedom of the air from dust, the average amount of moisture are all of the greatest moment."

Very often the best chunte for bronchite patients is a matter of experiment, and patients will frequently try several before they find the one that suits them hest—Probably the most important point is to find a place in which the patient can be the greatest number of hours in the open air, especially when this is combined with sinlight

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Crowded rooms, where the air is both warm and impure, should be sedulously avoided and going into the cold air after such an exposure is

specially apt to make such cases worse

Indoors, plenty of fresh air should be provided, but draughts must be avoided, and extreme cold, such as will occur in winter if the windows opened in the bedrooms it night, however useful it may be for tuberculous patients, is not suitable for bronchite ones. A temperature of about 65° F is usually the most satisfactory one for the pyticut, and marked variations from this, either up or down, are not advisable.

Many cases are caused, or at least made worse, by the inhalation of ting etc. Where possible, such pricents should be urged to change their work for one allowing of a purer atmosphere. But many better class patients are also affected by dust, and should avoid going out on the streets on dry, windy days and if they must do so should wear a miffler or respirator. The way in which the streets of some entres are cleaned is a constant menace to these people from the dust thus rused.

Glothing —The clothing of bronchitte pittents is an important matter Heavy clothing is objectionable in many ways and yet the westers must be kept warm. Perhaps the most suitable underclothing is that made of light and porous material, of which the patient ern we'r two sets in cold weather. In this way the total weight of the underclothing will be less than with one heavy suit, and yet he is more completely protected from chills by the air between the two layers. The suit next the body should be of some porous material, either cotton, linea, or silk, and the outer one may be of light wool. Chest protectors are, as a rule, not advisable. When people live in a cold climate and in heated houses, it is necessary to remember that the house temperature may be almost that of summer and hence does not call for thick clothing and yet the unitside temperature may be somewhere near zero. Such a difference is best mut by the use of a heavy overcoat.

Contagion — People suffering from chronic broachitis should avoid the proximity of individuals suffering from any acute catarrb, which is often very contagious, and acute attacks must be avoided, if possible. They are also especially susceptible to tuberculous infection and must hence avoid this as far as possible.

Tobacco — Inhalation of tobacco ...moko often excites a bronchial catarrh, and must be avoided not only by advising against the inhalation of cigarette smoke, but also by pointing out the fact that the mere hreath

ing of an atmosphere laden with tobacco smoke from the smoking of others is almost as had as direct inhalation.

Exercises - Exercises especially breathing exercises, are of great value in chronic bronchitis It should be remembered that in these cases there is always more or less emphysema, and that hence the normal elas ticity of the lungs, which in health is responsible for the expiratory act during quiet respiration, is more or less absent, which causes the expiration to become an active instead of a passive act. The result is that the excursion of the thoracic parietes is lessened, and stasis both of the respira tory tract and of the pulmonary circulation is apt to be more or less present Regular breathing everer es, with special emphasis upon expira tion, are hence valuable, and may with advantage be carried out several times a day. It is best that inspiration be done through the nose and expiration through the mouth. In this way the least possible obstruction is offered to expiration H E Knoof believes that he has been successful in curing cases of chronic bronchitis by systematic exercises in deep breath ing The exercises are done before a large mirror, with the chest hare, inspiration being performed through the nose and expiration through the mouth These exercises improve the general health in a remarkable way Anopf urges that this deep breathing is not only the most certain expectorant, but is also the only one that is entirely harmless. The only draw back is an occasional slight giddiness which, however soon passes off it is no doubt due to a mild degree of scapnia.

Compression of the lower part of the cheat is often of value. It should be done during the last pirt of equitation, and really continues this act in a passive way, so as to make the act more ample. It may be carried out by the nurse or physician, or, as G. Hoppe Seyler has pointed out, by the patient himself, who soon learns to do it. He is taught to place his hands on the sides of the chest, to press here at the list part of long expuration and finally to bend forward as if bowing which act forces the disphragin upward and thus lessens the diameter of the chest in the vertical direction. Various forms of pneumatic apparatus have been advocated from time to time especially almoad but as a vide the practitioner will probably do very well without them. Postural treatment of those cases in which the bronchal secretion is excessive will be referred to later on

When a patient with chrome bronchitis suffers an acute exacerhation he should be placed in bed, and treated as an acute case and with even greater care than usual

Diet and General Treatment—Crases of chronic bronchitis are generally below weight and low in general health and usually require to be fed up especially with fatty foods such as milk and cream. In some cases a general dyserasia such as gout or urema may be the cau e of the condition and may be best met by appropriate duet. In many of the German and Swiss spas, where chronic eather to the respiratory organs is treated,

such as Ems Ischl Reichenhall, etc., tho so called "whey cure' is much used It consists in the drinking of warm when, either alone or mixed with mineral water, in definite quantities at fixed times About 20 ounces (600 c.c.) are taken a day as a rule. It appears to relieve arritable laryngeal cough and to evereise a favorable influence over laryngeal and bronchial catarrh The whey is not, of course, the exclusive dict, and it is usual to limit the amount of animil food taken and to augment the amount of fruit and vertables At the spis the whey is made from the milk of goats and sheep, as well as from cow's milk I Burney Yeo spoke highly of it Like all spa treatments, this may be carried out at home, but is not there so successful as all the other good influences of the spa, such as rest, good air, regular hours etc., are upt to be missin. In children some dietetic error may be at the bottom of a persistent broughtal catarril, and the whole regime should be carefully gone into Habitual overfeeding or wrong feed in, may be present, and other treatment will be of little avail until this is attended to

The detary, as presented by Robert Hutchison for dyspepsia in children is here useful Starch puddings—such as rice sugo tapioca, arrowroot, and corndour—sweets, sweet cities, sweet fruits, jam, honty, marmal ide potatoes, turnups, carrots, should all be given in very small quantity or ent out altogether. The diet should consist chiefly of stale bread dry toust with butter or dripping eggs, beef, mutton, fish, chickin, hacon tonque grien vegetables in moderation, custard, plain puddings, stewed gruines, figs etc. The child should be permitted to eat only at meils. Ter coffee and other stimulants should be avoided. J. Allen calls attention to the value of this det in the persistent hynichists of children.

When chronic bronchitis occurs, as is not infrequent, in obese people, it usually proves very intractable. In such cases the obesity acts unfavorable, as is pointed out by Geo A Sutherland in three days (a) viscular obstruction occurs from merer ed resistance in the fitty tissues, (b) car diac weakness is present from deposit of fit about the heart muscle (c) pulmonary obstruction exists from excess of earbonic acid gas in the blood. It is necessary to remove the excess of fat, which is best done through three measures (1) a lean mart duet, (2) a saline aperient every morning. (3) where to be freely drupt between meals.

Cod Liter Oil—Cod liver oil, which may be here considered rather as a food thin a druit, is invaluable in the common thin type of the disease, and many patients, especially children, take it during the entire writer with great benefit G A Sutherland truly says, "The patient who has broughtits every writer will probably benefit more from cod liver oil taken throughout the cold months than from any other therapentic measure" As a rule it is not so necessiry, nor indeed so well borne by the stomach, in the summer If there be any anemia, then it is well to combine with the oil some salt of iron. This may be done in the form of one of the

numerous emulsions of cod heer oil and iron which are on the market, or one may give the plain oil and the svrup of the iodid of iron either separately or mixed immediately before being taken. Probably the chief advantage of cod liver oil hes in the fact of it being a fluid containing a very ordizable fat in a very fine state of division, and also from its large vitamin content, and those preparations from which the fat has been removed are not of the same value.

In many cases it is possible, by appropriate dietetic and other treat ment, to remove the underlying cause of the chronic catarrh this is the case in gout, uremia, alcoholism, and some other toxemias. Where the heart is primarily at fault, a bronchitis will improve as this organ becomes

strouger and more competent

Vaccune Therapy —Under removal of the cause should be considered accume therapy, by which the actual cause of the bronchial catarrh is at tacked through the raising of the patient's specific reasting power to the special infection present. The treatment is still upon its trial, but in some long standing cases of chronic bronchists it has seemed to prove of great value and it is likely that, as the technic improves, still better and more constant results will be obtained

An autogenous vaccine is the most reliable and where the infection is a mixed one, as is usually the east, the cheef form of organism present should be made into a vaccine. A C Latham, who has done much work here, says that one should begin with a small dose say one million dead bacteria. The effect should be an improvement in the patients sensations. Any rise in temperature means that the dose has been too big. According to Latham, the remedy may equally well be given hypodermeally or byte mouth in a little normal saline on an empty and beathy stomach.

Samuel West mentions several cases of chronic bronchitis in which an almost pure culture of pneumococci was obtained from the sputime. A vaccine consisting of ten to thirty millions of dead pneumococci was used, but the results were not at all encouraging

The treatment of bronchitus by vaccines is jet in its infancy, but in long standing cases it seems to open up an encouraging field for investigation. It is, however, expert work and cannot yet he looked upon as a routing treatment.

Serum Thorapy—Serum therapy has been tried in hronchits but without any striking risalits, indies indeed one include diphtheritic bronchits where brilliant cures have been frequently effected G Carmere has published a case of chrome bronchits of streptococcie origin which was markedly improved hy the use of anistreptococcie serim

In all cases of chronic bronchial catarrh the bouels should be kept regular. A fractional dose of some saline every morning is a useful way of bringing this about. In plethoric cases an occasional mercurial purge is to be advised in addition to this. such as I'ms Ischl, Reichenhall, etc., the so called "whey cure" is much It consists in the drinking of warm whey, either alone or mixed with mineral water in definite quantities at fixed times. About 20 ounces (600 cc.) are taken a day as a rule. It appears to relieve arratable larryngcal cough and to excreise a favorable influence over larvingcal and bronchial citarrh The whey is not, of course, the exclusive diet, and it is usual to limit the amount of animal food taken and to augment the amount of fruit and veltables. At the spis the whey is made from the milk of goats and sheep, as well as from eow s malk I Burney Yeo spoke highly of it I ike all spa treatments this may be carried out at home, but is not there so successful is all the other good influences of the spr such as rest, good air, regular hours, etc, are apt to be missing. In children some dietetic error may be it the bottom of a persistent brouchial catarrh, and the whole regime should be carefully gone into Habitual overfeeding or wrong feed ing may be present, and other treatment will be of little avail until this is attended to

The dietary, as presented by Robert Hutchison for dyspersia in children is hero useful. Sturch puddings—such as rice, sago, tapioca, arrowroot and cornflour-sweets, sweet cakes, sweet fruits, 14m, honey, marmalade potatoes, turnips carrots, should all be given in very small quantity of cut out altogether. The diet should consist chiefly of stale broad, dry toast with butter or dripping eggs, beef, mutton, fish, chicken, breon tongue green vegetables in moderation, custard, plain puddings, stowed prunes figs, etc The child should be permitted to eat only at merls Tca, coffee, and other stimulants should be avoided J Allen calls attention to the value of this dict in the persistent brouchitis of children

When chronic bronchitis occurs, as is not infrequent, in obese people, it usually proves very intractable. In such cases the obesity acts unfavor ably as is pointed out by Geo A Sutherland in three days (a) vascular obstruction occurs from mere said resistance in the fatty tissues, (b) ear diac weakness is present from deposit of fat about the heart muscle, (c) pulmonary obstruction exists from excess of carbonic acid gas in the blood It is necessary to remove the excess of fat, which is best done through three measures (1) a lean meat diet, (2) a saline aperient every

morning, (3) water to be freely drunk between meals Cod Liver Oil -Cod liver oil, which may be here considered rather as a food than a drug as my duable in the common thin type of the disease and many patients, especially children, take it during the entire winter with great benefit G A Sutherland truly says, "The patient who has bronchitis every winter will probably benefit more from cod liver oil taken throughout the cold months than from any other therapeutic measure" As a rule it is not so necessary, nor indeed so well borne by the stomach in the summer If there be any anemia, then it is well to combine with the oil some salt of iron This may be done in the form of one of the

B	Sodu bicarbonatis	gr	XV	100 gm
	Sodu chloridi	gr	v	035 gm
	Spiritus chloroformi	min	v	0 35 ес
	Aqum enisi	ad oz	1/_	1500 cc
	Misce fiat mistura			

Sig. To be taken in a glas of hot water on fir t waking in the morning

The writer has frequently found this mixture of great value

Another useful remedy with the same object is Ems water, of which 3 or 4 ounces should be taken in bot milk on first waking or the old fa hioned rum and milk may be used with advantage

In cases where, during the night, the cough is dry and the sputum difficult to cough up the alkaline mixture given above may be used with herefit at helymon as well

Laniments Poultices and Sprays — Laniments are frequently of value un chronic bronchitis. They are the same as recommended in acute bronchitis and used in the same was Poultices and fomentations are not required in chronic bronchitis, but during any little exacerbation a mustard leaf over the upper part of the sternum often gives relief in cases of chronic bronchitis with scanty sputum mild alkalino sprays are often of value, such as Seiler's solution

Cough -By the use of means, such as those indicated, to make the secretion more fluid, the cough may be so much relieved that it needs no special treatment. But frequently the cough remains excessive and is indeed the chief symptom complained of It may by keeping up an irritation in the upper air passages make the catarrh worse and a vicious circle is established-the cough causing the irritation which in its turn causes the cough. In every case of cough it is most necessary that the practitioner before employing any remedies for its easement fully consider if the cough he a useful one and, if so whether it be excessive or not As an example of an absolutely useless couch one may cite that produced by a dry pleurist, and as a type of a useful one that set up by the presence of a removable foreign body in the air passages. The first of course, may be freely checked, while the latter should be encouraged or at least left alone. The same rule holds good in the coughs accompanying bronchitis In one case a dry arritable cough may be making the patient miscrible and yet is only doing harm and should be checked while again another patient may be coughing only to get rid of a quantity of secretion which is threatening to asphyxiate him, and such a cough of course should be encouraged

Insomma is frequently produced by con_him; and the late Dr Gus tave Schorstein of the London Brompton Hospital used to av that the best hypnotic in chronic bronchitis was streahm. It of course acts by helping the cough and thus clearing the tubes of secretion, the presence Symptomatic Treatment—Txpectorants—The use of expectorants in chronic brouchits has been built up entirely on empirical lines. The majority of the luty still believes that every esse of cough should have a cough mixture. No doubt the profession also has tended too much in this direction, and now there is a swing of the pendulum in the other direction. Expectorants, however, hold an important place in the treat ment of chronic bronchitis, and when carefully used, after a full consideration of the nature of the esse, are often extremely useful in allaying the symptoms.

In the majority of cases of chrome entured the cough is not excessive, and if the expectoration be brought up easily, then expectorants are not required, and our efforts should be directed toward the prevention and lessening of the reute attacks and the raising of the general health by the use of tonics, proper feeding, etc., in order to bring about a more healthy condition of the bronchial mircons membrine. Where, however, the sputum is senity and tough and the patient coughs much with little result, those expectorints which tend to make the scerction more watery are in dieated. The ones that act best in chronic bronchitis are the stimulating expectorants, chiefly squills senegr and ammonium earhouste (see page 44) The rodids also act in this way and are specially indicated in gouts eases and in those cases where, along with a tough and seanty sputim, there is a tendency to wheezing and asthma. They are best given well diluted half an hour before meals, and the dose need not be more than 2 to 5 gr Iodipin is a valuable body, and may be given with little risk of disturbing the digestion or producing other symptoms of iodism. It is said not to be split up in the stomich, but to be absorbed from the intestine The greater part of the iodipin is oxidized in the body, and when this oxidation takes place all the iodin separates out as iodid. This action, however, is slow, and iodin may be detected in the urine for weeks after the treatment has been discontinued, according to James Burnett The 10 per cent solution can be given in 1 or 2 dram does mixed with a little warm milk, or the solid form may be used. This is a brown substance and may be had in tablet form

In many pitients the chief difficulty is in the morning On first waking the patient coughs and coughs until he brings up some tough spitim which has accumulated during the sleeping hours. He may even the force he succeeds in emptying the air passages coughed up this material, he may be faully comfortable for the rest of the day. In such cases, and they are very common, a warm alkaline aromatic draught taken on first waking usually gives great relief, by rendering the secretion more final and thus easily got rid of

Such a prescription as that added to the Brompton Hospital Phar macopena at the suggestion of Dr Burney Yeo may be used. It is as

follows

As a rule oprum is contra indicated in chronic bronchitis, but in these irritable ca es it is often of value and may be used cautiously in small amounts Paregoric, compound specieuanha powder, and pill of specieuanha with squilla are good preparations here. A useful prescription for controlling imnercessary, coughing is the following.

II. Laquoris morphimæ hydrochloridi dr 1 400 cc Acidi hydrocyanici diluti dr ½ 200 cc. Syrupi pruni virginianæ oz ½ 1500 cc Infusi rosa acidi ad oz in 100 00 cc Miscae fi fat mistura

Sig A teaspoonful without water as often as every four hours

This forms a mixture which is very soothing in an irritable cough. Its action seems to be partly local and hence is best marked when the medicine is taken undiluted. As a rule, however in such chronic coughs as we are discussing the use of sedstive cough mixtures if employed at all, should be reserved for the undit

It is searcely necessary to say that in a chronic condition like the one ninder discussion opiates in any form should be avoided as largely as possible and if a priscription containin, such is for a time considered necessary it abould be marked not to be repeated, in order to avoid the possibility of the patient acquiring the opium babit

Profuse Expectoration.—With very profuse expectoration the medicinal treatment is quite different. Here the cough is life-saving and nothing must be done to check it, but, on the contrary if the patient be weak and the muscular power low, it should be encouraged. This can be best done by the use of strychinn. Our efforts should be directed toward lessening the amount of secretion, both by raising the general tone of the patient by the use of conies good food, etc, and more directly be the use of certain drugs which base the power of directly lessening the abnormal secretion. Such drugs are belladonna the mineral sends, and the so-called aromatic expectorants.

Belladonna acts powerfully as a drier up of secretion and also as a reprintory stimulant but must be used with care as it tends also to dry up the saliva and other secretions, and may give rise to discomfort in consequence. Its active principle attopin, is a very powerful stimulant of the respiratory center it also lessens the respiratory reflex dulling the terminations of the tagons and thus tends to ever the cough, but this dulling action is not so marked as it is in the case of opium, and the other contra indications are not present. The tineture of belladonna may be given in doses of 10 minims (0.6 c.c.) thrico dully and will certainly lessen the amount of secretion. Sometimes, however, it will be found that, although the secretion be lessened the patient is not so comfortable

of which keeps the patient coughing and hence awake. It may be given in the form of the hydrochlorid or sulphate in doses of 1/60 to 1/20 gr (0 001 to 0 003 gm) either by the mouth or hypodermically, or mux vomice may be used in doses of 5 to 10 minims of the tincture, either by itself or added to any other medicine that the patient is taking A useful prescription for cases with moderate secretion is as follows

B

Tincture nucis vomicæ	min v to	₹ 035070 cc
Tincturæ scillæ	min xx	12a cc
Ammonii carbonatis	gr m	0 20 c c
Syrupi tolutani	dr 1/2	2 00 cc
Infu 1 senegre	adoz 1/2	15 00 cc
Mrsce et fiat mistura		

Sig Thrice daily after meals

An old recipe which the writer has often found useful in cases having a good deal of cough and a small amount of sputum is the following

B Tincture camphore composite Oxymellis cille Syrupi tolutani aa 5i (30 c c ) Misce fiat mistura

Sig A tea poonful from three to six times daily in water

Often the cough is largely kept up by an irritable condition of the pharynt, and in such cases barley water, flavored with lemon, is a pleasant and efficient remedy and will frequently relieve an irritating nocturnal cough, if supped as required. In cases of this kind it is important to tell the patient not to cough if he can possibly help it, the cough keeping up the irritation. Such advice is on a parallel with telling an individual with an itchy eczema not to scratch. In both cases many unnecessary irritations of the inflamed parts may thus, by the exercise of the will, be stopped.

In cases with much irritation of the upper air pissages, sprys, as already mentioned, are useful. Also inhalitions from the handkerchief or through a Burney Yee or some other form of inhaler. Ten drops of a 20 per cent solution of menthol in alcohol poured on the sponge and used for hours may give much relief. Or the following

B Menthol 1 part
Euculyptol 2 parts
Benzoinol 3 parts
Misce fiat mistura
Unbale from an inhaler or handkerchief

c

It is given in doses of 5 to 15 drops, conveniently dropped upon lump sugar, or it may be dispensed in capsules, or as a draught such as that of the Victoria Park Hospital, which is as follows

B	Terebeni Mucalaginis tragacanths	min	I	0 60 c
	Glycerini	ıa dr	1	400 c
	Aquæ cinnamoni	ad oz	ı	30 00 c

Sig To be taken thrice daily after meals

Or the aromatics may be inhaled and thus more directly applied to the diseased mucous membrane. Such a mixture as this is useful

B Terebeni Acidi carbolici liquifacti

Spiritus chloroformi aa 511 (8 00 cc)

Sig To be inhaled from a Burney Leo inhaler for hours daily

Or one as recommended by J C Briscoe

В	Creosoti	dr 111	12 00 ce
•	Thymol	dr 11	8 00 gm
	Acidi carbolici liquifacti	dr 1	4 00 ce
	Spiritus chloroformi	ad oz 1	30 00 ∟e
	Misce et flat mistura		

Sig To be inhaled frequently

Or one may use the inhalation containing menthel and cucalyptel in benzoinel already given (page 56)

Various sprays may also be employed here such as one of Seiler's solution or one of ipecacuanha wine as recommended by Ringer and Murrell

Among the newer and less commonly used methods of treatment of chronic bronchitis one may mention the following

A ray —The X rays have been tried in chronic bronchitis, and some good reports of the results have been published. Thus Dr Schilling of Nuremberg at the German Congress of Medience in 1906 stated that be had treated a number of patients in this way. With one exception the had treated a number of patients in this way. With one exception the results were favorable und the bronchial secretion decreased. Even in cases of months duration the expectoration became less copions and in some instances totally disripe ared without any undestrable complications. The general health of the pytients was unproved and their re-piratory difficulties were lessened. One would of course like to know more about these patients—for example, whether any of them were of vears duration.

The mineral acids especially the nitro hydrochloric acid, are valuable in lessening expectoration, as in the later stages of acute bronchitis

The aromatic expectorants such is creosote and terebene tend to lessen bronchial secretion. They are specially indicated where any fetor exists in the secretion, and will be inferred to later.

When the bronchial secretion is excessive, posture is an important factor in the treatment of the condition As is well known, in health the cilia of the epithelial cells lining the respiratory truct are constantly tend ing by their movements to bring the normal secretion, and with it any particles of dust which may have alighted upon it, toward the outlet of the respiratory tract, where it is swallowed or expectorated But, when the epithelium is changed, as it is in chronic charrh, and the cilia no longer are there thus to move the secretion ouward, this material, often excessive in amount, collects in the air passages and must all be coughed up If patients with excessive secretion can be made to sleep with the foot of the bed a little rused, gravity helps, or at least no longer retards, the passage of this secretion toward the ontlet F Forchbeimer specially emphasized the value of this postural treatment. The foot of the bed should not be raised more than two or three mebes at first, but gradually can be put up to double that height. Beds are now made by various manufacturers, the ends of which can be conveniently raised or lowered to any desired degree by means of levers acting on cogs

In rare instances the expectoration in cases of chronic bronchitis becomes fetid. In such instances there is always a suspicion of actual citiatation of the brouchi, which may be marked enough to merit the term of bronchicetasis. In futil cases the aromatic expectorants are indicated

Aromatic Expectorants—Crossole is much used, and as best given in pearls or capsules contaming 2 or 3 minms in each Or it may be given as the misture crossit of the B P, or combined with cod liver oil Guatacol carbonate a derivative of crossote, is a assful expectorant here, and if given in doses of 5 to 10 gr three daily or every four hours (in capsule form), it will soon show its characteristic odor in the breath Tar in doses of 5 to 10 minims (0 3 to 0 6 cc) in capsules, may be given with the same object

Turpentine may also be used in such cases, and can be given in capsules containing 5 to 10 drops, or in a mixture as follows

B. Olei terebinthinae dr 1 400 cc
Mucilaginis scaciae oz 11 6000 cc

Emulsionis amygdalæ Misce fiat mistura oz 11 60 00 c c ad oz v1 200 00 c c

A table poonful thrice daily after food

Terebene is another aromatic which is employed in such cases. Its odor is more pleasant than that of turpentine, which it otherwise resembles

Pilocarpin acts in the same way and may be given by the mouth in expectorant doses of 1/20 to 1/10 gr (0 003 to 0 006 gm) of the nitrate or hydrochlorid every four hours

Apomorphin also acts as a producer of freer secretion, and may be given in small doses for this purpose. Doses of 1/32 to 1/10 gr (0 002 to 0 006 gm.) of the hydrochlorid given by the mouth every two to three hours will soon produce an abundant secretion. The emetic action of this dru, is not nearly so well marked when it is given by the mouth as when given hypodermically on the other hand, the expectorant action is better developed, and hence it should be given in this way in this disease.

In severe cases it may be advisable to use an emetic with the double object of producing a free secretion from the bronchial mucous membrane, which always accompanies nausea and also to produce vomiting, which

may at the same time expel the contents of the bronchi

Ipecacuanha in 20 gr (13 gm) doses will act well here, or perhaps better still a bryoderme injection of 1/15 to 1/10 gr (00 00 to 0 000 gm) of apomorphin When however, tho patient is very distressed and evanosed, it becomes a nice question to judge whether one should on should not run the risk of heart failure from the use of an emetic. In a case seen with the late Dr R J Dwyer the patient was so near death from a phyxia that we foared to put any further strain on the heart failure faired much dilated. However, after the patient had become almost black from eyanosis, pulseless, and apparently practically dead, she herself counted and soon brought up a quantity of sputium containing an almost complete cast of the respiratory tract below the trachea and then completely recovered. In a similar attack which occurred some months later—she died before skilled assistance was obtained.

The fact that the easts are soluble in Immewster led to the suggestion by Biermer that an inhaltition of atomized limewster be used and a case of its successful employment was reported by Waldenburg. No recent reports of its use have been made. Inhalations of creesste vapor have been suggested by Fowler and mught be tred. It can be conveniently inhaled from a Burney 1 to zine inbuler, and if too irritating may be mixed with equal parts of sourit of chloroform.

Morphia is of all drues the one most contra indicated here and should never be used to relieve the distress. It dress up the secretions, les cans the lung refer and tends to weaken the respiratory center. In one case within the writer's knowledge it seemed on several occasions to precipitate an attrok.

## BRUNCHIECTASIS

Environment —It is no t essential that the patient's general health should be kept up hy abundance of pure fresh air and plenty of nourishing

as many a subacute bronchitis lasting a few months clears up completely under almost any treatment

Incandescent Light Baths—A von Strumpell strongly advises the use of Kellogg's incundescent light biths in chronic bronchitis. In his bands the treatment seemed to be very successful. It is specially advised in the dry form of the disease. The light produces hyperemia of the skin and sweating, and should have some counterprinting effect, if nothing more

Other Remedies—As has been already stid more than once, cases of chronic bronchitis are of all degrees, from those that are so slight as to be scarcely considered all to those who are more or less completely invalided. These severe cases tend to get gradually worse in spite of all treatment, and, eventually, from increasing emphysema and failing right heart, become completely invalided. In such case, where the dyspica is marked and there is more or less evanous, the inhalation of oxygen is marked and there is more or less evanous, the inhalation of oxygen is the rate of about 120 hubbles per minute, and inhaled through artibber tube placed in a nostril, or by means of a special inhaler such as the Meltzer.

Strychnin hypodermically helps these sufferers very much and should be freely given. Alcohol especially good brands, is often valuable, par ticularly in the aged. The heart must be supported in every way possible in these advanced cases, and digitals is usually given freely and with some benefit occasionally.

some benent occasionally

When cyanosis is marked, bleeding helps to keep the patient going a
little longer sometimes, and may be repeated at intervals of a few weeks
with temporary benefit on each occasion

# PLASTIC BRONCHITIS

Plastic bronchitis is a rare disease, the essential nature of which is far from clear. It is characterized by the periodical formation in the bronchial tubes of a fibrinous material, which, after causing much distress from dyspines, is thrown off and expectorated in a more or less intact condition as casts.

Treatment — So little is known about the essential nature of this disease that we can give no general directions to our patients, beyond those bearing upon the improvement of the general health No diet has any perceptible effect upon the condition

When an attack occurs, the one drug that has proved of undoubted value is the coded of potassium it no doubt acts by causing a pouring out of thin bronchial secretion which helps to loosen the adherent casts. It should be given in repeated doses of say 2 to 5 gr every four hours. These small doses have a more marked tendency to produce iodism than have the larger ones, and this is what we want here.



56 SOME PHYSICOCHEMICAL PRINCIPLIS IN THER YPY

eased human body, distributes atself in such a way between the various (colloidal) phases that make up the human body as to appear in a toxic concentration in the cell or organ under consuleration before it does this in any other or all the other cells or organs of the body

It is well here to emphasize again the fact that inforcation at all times depends upon the concentration of the toxic substance present, and not upon the absolute amount given. The whole principle of detovication depends upon the recognition and u e of this fact. We can easily illustrate which we ment when we discuss the intorecation that goes with any acute infection. Here we have an organism producing a poison at a fairly uniform rate. When, we do not possess a specific therapy much of the art and science of treatment consists in keying the concentration of this toxic substance as low is possible. How do we manage this? When we cannot influence the factor of toxin production, we have only one way at our disposal, and that is to keep the concentration of the toxins as low as possible. To do this we can do but one thing, namely, give water

As we noted above the giving of water makes for a secretion of water, and this secretion of water is necessary lafore we can get a secretion (washing out) of any toxic substance By washing the toxic substances out of the kidney cells, for example, we break flown the equilibrium existing between the toxic substance here and that in the blood So more toxic substance will move from the blood over into the kidney to be eliminated if the third phase is created by giving water But when the toxic concentration in the blood falls, the toxins from the cells will more over into the blood, and the lower we can keep the toxic concentration in the cells the less the intoxication and consequent pathological effect upon them Now we also see the sense of giving water not only in a haphazard way as the patient may desire it, but in specified doses at regular intervals day and night Otherwise during the periods of water absteution the toxin concentration will run up What happens is illustrated by the variation in the concentration of the normal constitu ents eliminated in the urine in any twenty four hours. Since we are accustomed to consume most water with our meals, the urine after our meals is pile and low in urmary constituents. It is deep-colored and highly concentrated on rising in the morning, for through the night we do not consume any water

# OSMOSIS AND QUESTION OF CELLULAR 'MEMBRANES

In our analysis in physicochemical terms of certain phenomena familiar to every worker in the art and practice of medicine we have almost ignored the much discussed question of osmotic pressure. We have not

To-day ne may safely say that ne do not know a single cell for which

the laws of osmotic pressure are taild

We need not go into details to prove this If cells obeyed the laws of osmotic pressure then they ought always to have the same volume in isosmotic solutions of different substances Freeptions to this conclusion are the rule Again, with every merca c in the concentration of the medium surrounding a cell we should get a proportional decrease in the volume of the cell. As a matter of fact, the shrinkage is always less than anticipated (Koeppe, Duris) While electrolytes and non-elec trolstes are in our laboratory o motie cells equally active when the same number of dis olved particles are pre ent in the unit volume, this is not the case in living cells. Generally speaking the electrolytes are active out of all proportion to the non-electrolytes when living cells are concerned How all the e facts are readily explained on the colloidal bisis has been pointed out above

To have the laws of esmetic pressure tenable for living cells we must have semipermeable membranes about them. Only as this is the cale can changes in osmotio pressure become available for the movement of water into and out of cells If for the sake of argument, we grant this conclu sion then no dissolved substances can get into or out of the cell Such a conception of the cell is impossible for under such circumstances how could a cell get its necessiry food, or how could it rid itself of its various metabolic products? To get around this difficulty various observers have made these esmotic membranes permeable to some or many dissolved substances. But the moment we grant this we can no longer maintain differences in esmotic pressure and so water can no longer be absorbed The adherents to the view that o motic membranes exist about cells can take their choice either they can utilize their conception in order to make water more or they can have the e membranes rerneable and so have his olved substances more-lit they cannot have both

An enormous literature has spring up about this que tion of mem branes surrounding cells From the original a motic membranes of Pfeffer which were semipermeable we have come to the e which are partially permeable and then to the e which are permeable ometimes and then again not But even the e complicated notions encounter trouble, for there is so little connection between the kind of sub-times that enter cells and the that do not Only the members of one group-that which has a ready solubility in the fats-have been recognized as having one property in common and to account for their reads entrance into cells the osmotic membrane about cells has been endowed with Inpoidal character istics The infortunate part about this theory which is in e ence that of E Overton is that while it renders easier our conception of the alsorption of the c lipoid-soluble substances it makes it impossible to get the ordinary salts and water into cells for these are not particularly

and a precipitate of copper farrocyanid is deposited here. The copper colution may now be washed out of the pot and the ferrocyanid rinsed off the outside. In the wall of the pot remains a "precipitation membrane" of copper ferrocyanid. This membrane allows water to pass through it casil, but it will not allow substances dissolved in this water to get through. The membrane is "compermeable," and therefore is identical in this property with the "osmotie" membrane that Pfeffer maintained surrounded the hving cell. If the laboritory cell is filled with a solution of any kind and is then placed in water, water is sucked into the cell, if it is placed instead in a more concentrated solution, water is sucked out of the cell. As is readily apparent, this corresponds to what Pfeffer and DeVries observed in the case of the living cell.

Pfeffer made many osmotic measurements with his laboratory cell, and, on the basis of his observations, van't Hoff some years later formulated his famous laws which are as follows

1 At constant temperature the esmotic pressure of dilute solutions is proportional to the concentration of the discovery largeless.

2 At the time temperature equal volumes of all thlute solutions having the same osmotic pressure contain the same number of dis olved particles

3 At constant volume the comotic pressure of any colution varies directly as the ab oluti temperature

The work and conclusions of van't Hoff and the physical chemists now became retrouctive and the attempt was made to apply the laws of van t Hoff not only to the laological facts that Del rice and Pfeffer had furnished, but to the additional ones contributed by Hamburger, Grous, Loeppe, Loeb, Hober, Overton, Webster, etc. To this end the observa tions made on plant and numel cells were compared with those made with the laboratory osmotic cell When a solution of any electrolyte or non electrolyte was found not to change the volume of hound in an osmotic cell, it was said to be "isosmotic" with the cell contents. Family concentrated solutions of all kinds were found to be isomiotic with the contents of the osmotic cell The e were, therefore isosmotic with each other When a solution of any kind was found not to change the volume of any living cell it was said to be "isotonic with the contents of this cell In this way the solutions of many different substances were com pared and the 'isotonie coefficients' determined in each case. If the laws of osmotic pressure were active in hving protoplasm, it was therefore to be expected that, if certain solutions were isotonic with each other, they should also be "isosmotie" with each other

When the first rough comparisons were made it was in fact thought that the isotonic solutions were isosmotic but this conclusion could not stand the pressure of more careful and more numerous observations To-day ue may afely say that ue do not know a single cell for which the laws of comotic pressure are talled

We need not go into details to prove this. If cells obeyed the laws of osmotic pressure, then they on, ht always to have the same volume in iso motic solutions of different substances. Exceptions to this conclusion are the rule. Aguin, with extr. increase in the concentration of the medium surrounding a cell we should get a proportional decrea on the volume of the cell. As a matter of fact, the shrinkage is always less than anticipated (Koeppe Durig.). While electrolities and non-electrolities and non-lectrolities and in our laboratory cosmotic cells equally active when the same number of dissolved particles are pre-sent in the unit volume, this is not the case in living cells. Generally speaking the electrolyties are active tout of all proportion to the non-electrolytes when living, cells are concerned. How all these facts are readily explained on the colloidal hasis has been nonted out alove.

To have the laws of osmotic pressure tensible for living cells we must have semipermeable membranes about them. Only as this is the case can changes in countie pressure to come available for the movement of water into mid out of cells. If for the sake of argument, wo grant this conclusion them no dissolved substances can get into or out of the cell. Such a conception of the cell is impossible, for under such circumstances how could a cell get its necessary load or how could it rid itself of its various included in the counties. The constitution of the cell is impossible, for under such circumstances how could a cell get its necessary load or how could it rid itself of its various included in the control of the cell is impossible, for under such circumstances have made these osmotic multipasses permanded to some or many absorbed abstances. But the moment we grant this wo can no longer maintain differences in estimate the view that o motic' membrance cuts about cells can take their choice either they can utilize their conception in order to make water more or they can have these membranes permentions of the control of the control

An enormous literature has spring, up about this quistion of membranes of 1 fefix which were emipermeable, we have come to the e which are puttally permeable, and then to the e which are permeable, and then to the e which are permeable, and then to the e which are permeable, and then gain no. But even the e compleated notions encounter trouble for there is a little councetion between the kind of substances that enter cells and the or that do not Only the members of one group—that which has a ready solubility in the fata—have been recognized as having our lorperty in common and to account for their ready entrance into cells the common man to account for their ready entrance into cells the common and to account for their ready entrance into cells the original permeable of 1. Overton is that while it renders causer mur comption of the absorption of the elicondonlable substances it makes it impossible to get the ordinary salts and walter into cells for these are not particularly

soluble in the lipoids. And yet we know from physiological and pathological facts that both must be able to get into cells

Moreover, what do we gain when we have succeeded in getting some dissolved substance or water through any membrane postulated to cust about a cell? It would colket here and we should still have to account for the movement of either the dissolved substance or the water into or through the rest of the cell protoplasm. There are no membranes about cells neither of the lipoid type (Durg, Pauli, Fischer), nor of the 'osmotic' type (Ischer). All the phenomena which offer so much difficulty in explanation when we assume that membranes cost about cells are readily interpreted, without recourse to such postulates, on the basis of the colloudal constitution of protoplasm as we indicated above

In answer to these arguments some of our critics here retorted that membrano' exists wherever two phases come in contact with each other. At this point we have to stop and begin to define terms, for ker the arguments begin to become academic. A drop of any finld, a drop of any colloud solution, a drop of protoplasm or a cell, has a "membrano' about it, but thus membrane' is simply a surface tension film, it has nothing in common with the "osmotic membranes" that are in tirri talked about by the bostimest whe physical chemists, and the original animal physiologists who worked in this field. These surface tension films are chemically identical with the rest of the cell protoplasm and (except as colloidal particles tend to collect in these surface films and so russ the concentration of these particles bert) as such behave loward index or dissolied substances exactly as does the rest of the cell protoplasm.

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### CHAPTER II

## NUTRITION AND DIETFTICS

## WAPPEN COLEMAN

### PENISED BY FOWIN G GRO S

Some knowledge of the laws of mutrition, as well as of dietetics, is requisite for the rational construction of dietaries, whether they be in tended for persons in health or for those ill from disease

Nutrition concerns the digestion and absorption of foods, the destinies and transformations of the foodstuffs after absorption, and the energy

liberated within the body by their oxidation

Directics on the other hand relates to the selection of foods the arrangement of dietaries which cover the nutritive requirements and, at the same time, conform to the likes dislikes and idiosyncrasies of persons,

and the methods of preparing and serving the food

A knowledge of the fuel values of foods is hkewise essential to rational feeding. The body derives energy from food in much the same manner that an engine does from each. The universal law of the conservation of energy holds for the body as well as for the engine that is the body develops through oxidation a definite amount of energy from a known quantity of food. Since the total energy which the body requires for the performance of its functions is accurately known, the fuel values of all duets should be carrefully adjusted to the patients needs.

No attempt will be made to discuss here the dietetic treatment of the different discuss. For such details the reader is referred to the appropriate chapters. The purpose of this chapter is to furnish simply the information with the aid of which diets may be arranged for any discuss.

### FOODS

Voit defines a food as a palatable muxture of foodstuffs which is capible of maintaining the body in an equilibrium of substance or capable of bringing it to a desired condition of substance. The ideal food is a palatable muxture of foodstuffs arranged together in such proportion as to

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animal fats are chiefly mixtures of the esters of olic, stearic and palmitte and. The fat of milk contains besides these, considerable amounts of the lower fath ands such as butting, caproic, caprylic and capric acid. The triglycerids of linoleus, lauric, myristic, etc., are found in great abin dance in the vegetable kingdom.

In addition to the nentral fats foods contain various fathlike substances known as lipoids, some of these lipoid substances may have considerable importance in nutrition but as yet we do not know their exact importance. Representatives of the lipoids are cholesterin and lenthin

Vitamins—Vitamins are or anic substances of unknown chemical constitution they occur in small quantities in many foods, and are of the utinost importance in putrition

Inorganic Substances — The morganic substances are water and the alts of sodium, potassium, magnesium, chlorin, sulphur, phosphorus, iron and indim

#### USES OF FOODS

The chief functions of food are (1) to yield energy, (2) to build tissue (3) to regulate body processes

Uses of Proteins —I rotems are the only foodstuffs, capable of supplying the introgenous needs of the body while all the organic foodstuffs are capable of furnishing energy. Both vegetable and animal proteins are apparently equally serviceable in furnishing the introgenous needs. As a source of energy, protein, in animously recommended by Vott and At water represents from 16 to 20 per cent of the total metabolism and a lesser amount in the stundard recommended by Chittenden.

The protein molecule consists of about 50 to 60 per cent of a car bonaceous group or 'carbon mosets' which is split off and outlied like carbohydrate to carbon downd and water. In diabetes mellitus part or all of this, depending on the severity of the case will appear in the urme as glucuses.

The nitrogen of protein taken in exects of the body's needs is rapidly exercted, appearing in irrine chieft in the form of urea. There is a nitrogen retention in the body during growth, pregnancy and convales conce from wasting discusses

Idequate and Inadequate Proteins—Some proteins when fed together with sufficient non protein material, vitamins, water and salts, furnish all the introgenous compounds necessary for growth and main tenance others under the same conditions fail to support growth or maintenance or both. The former group may be called adequate proteins and the latter inadequate proteins. The difference in the two groups is in their makeuply of amino-acids. While the body can synthesize main of the amino-acids which it uses it apparently cannot synthesize critical ones which are necessary for maintenance and growth

burden the organism with a minimum amount of labor. It should be added that the vitamin content of the food must be unimpaired.

#### Toodstures

Preciscally all of our foods, as ordinarily served, are mixtures of food stiffs. A foodstuff is a material capable of being added to the bodys substance, or one which when absorbed into the blood-stream will prevent or reduce the wasting of a necessary constituent of the organism (Linsk).

I codetuffs are classified as follows (1) proteins, (2) carbohydrates,

(3) fats (4) vitainius (5) inorganic substances

Proteins—Proteins may be defined as complex or anne compounds of high molecular weight made up of earlon, hydrogen, oxygen, nitrogen, sulphir, and sometimes containing phosphorus and iron. Protein contains introgen up a form available for the physiological needs of the organism, and this differentiates at from other food tiffs. Considered from a chemical standpoint proteins consist wholly, or in part, of amino-acids united by their carboxyland man more rooms.

Proteins are found in nature in livin, matter, or associated with it, and always produced by it. They comprise fliedth, easelin, egg albumin,

gluten, edestin, etc

Carbohydrates — Carbohydrates are abundant in the plant kingdom, forming the clief mass of the dry substance of the plant structure. In animal tissue, this are found in small quantities either no free condition or in combination with nitro-crimous substances. The carbohydrates are the chief source of carry to the lody and therefore are of great importance in intrition. They contain the clements carbon hydrogen and oxigen, the last two elements are usually in the ratio of 2.1, but not all compounds having this ratio are carbohydrates as (CII₂COOH) accurated

It is difficult to give an exact definition of carbohydrites, however chemically they may be defined as aldebyds or betones of the pohylydre alcohols. The carbohydrates are generally divided into three group monosaccharids such as devitore and levulore, disaccharids such as sucrose, milto e, and lactose, and polysrecharids such as strech, dextrin, and cellulose. The cading "ose" is given to the monosyccharids and disaccharids according to the number of carbon atoms contained in the molecule. Thus, one species of a pentose C H₁₁O₆, or a hexose C₆H₁O₆, or a hexose C₆H₁O₆.

Fats — Fats are distributed widely in both animal and plant kingdoms. In the latter they occur chiefly in the seeds, fruits, and in some instances in the roots. They occur in all animal tissues in surviving quantity.

Chemically the neutral fats are the glyceryl esters of fatty acids The

neum, and the tissues about the kidneys. These depots constitute a reserve upply of fit to be called upon in time of need. The duration of life under the condition of streatune generally depends upon the quantity of fit present in the organism at the start (Linsk). The sources of the body fat are the fat of the food which may be deposited without change, and carbohydrate, which is readily transformed into fat.

It has not been definitely proven whether fat can be formed in the human body from protein however the evidence tends strongly to substantiate such a view. Fits mix be formed from carbohydrates but the exact mechanism of the process is still somewhat obscure. It is likewise uncertain whether clusocene can be formed from fat.

Uses of Water—Approximately two-thirds of the body consists of water. Water forms an integral part of practically all the tissues, and serves as a means of trusportin, intrincits to and waste products from the cells. Since water is constantly given off from the body through the kidneys skin lungs, and in the feces it is evident that to muntain the composition of the tissues, there losses must be made good. Animals die sooner of thirst than of hunger. Deprivation of water causes not only a change in the composition of the tissues, but appears to lead to the devel opment of force albuminous products.

The average daily water requirement is shout two liters, of which order in staken in the form of solid food. The demand for water in health varies dren't with the losses which in turn vary with the amount of exercise the external temperature and the character of the diet. A diet consisting largels of protein interests the desire for water. The variations in the damand for water which are occasioned by disease are seen in fivers tabletes multiples and thronce interstitute inclusives.

Deprivation of water increases the destruction of protein in the imajor ity of instances, though to a less extent in fat than in spare persons. Paw loo has called attention to the diministron of the gastine and pancreatic secretions which follows a deficient intike of water. Limiting the amount of water does not increase the destruction of fat as was formerly believed. This fact has averal stemificience in the treatment of obserts.

Uses of Salts—Organic life is dependent upon the presence of salts Salts enter into the composition of living matter, and therefore are true foods

The elements concurred in mineral metabolism have a diversity of important functions in the body. The skeletal structure of the body, namely bon, owers its permanence and rigidity to its composition of the mineral exits furthermore they are essential solid constituents of the sort it sues of the body such as maseles, etc. By virtue of their being oluble, its held in solution in the various fluids of the body, they exert their influence in blood-clotting irritability of muscle and nerve and the maintenance of the slight ablade cence of the body fluids at the same

Gelatin is an imadequate protein, as, while it is readily digested and ovidized to earlient dioxid water, and urea and vields energy, it is acapable of maintaining the body in mitrogin equilibrium. Gelatin is deficient in tryptoplan, tyroun and eystin. Osborne and Mendel working with other deficient proteins have come to the conclusion that the amino-acids, bein, tryptoplan and existin are necessary as constructive units in growth, and that tryptoplan and existin are necessary for maintenance.

Under practical conditions however, we are not dealing with singlepurified proteins since our common protein foods all contain mixtures of proteins. Thus any of the foods will firmuch more than one protein. Osborne and Mendel have demonstrated that proteins will supplement each other.

Uses of Carbohydrates —Carbohydrates are the chief source of the body's energy, whether expressed in the form of muscular work or in the form of heat. The earlohydrate of the food is transformed into givegen mod stored principally in the liver and imusels; until needed. An excess of earbohydrate over the daily needs leads to more complete filling of the plycogen depots or it is transformed into and stored as fat. The body has not however an unhanted tolerance for earbohydrate. If the much be taken sugar appears in the urine, producing alimintary given uria. This is especially true for sugars. It has been stated that no amount of starch in the food can can expression direlection or the open disposed to the disease, because of its slow rate of absorption.

Another function which exclusive is now rate of absorption.

Another function which exclusivate serves us to spare protein. When nother earbohydrate nor fut is available, as in the late stages of stars at one practicular all of the energy is derived from protein. If protein and carbohydrate alone or protein and fat alone be given to an animal, less protein is destroyed with a liberal simply of carbohydrate than a liberal simply of fat. Hubber enceeded in reducing the introgen output of a starving man one-half by giving earbohydrate. Carbohydrate is a better space of protein than fat. But if both earbohydrate and fat be given, in addition to protein, then appear to be dynamically equivalent evolves for calory. I andergrun found that a diet furnishing one-half of its calories as fat and one-half as earbohydrate protects protein as completely as a diet composed entirely of earbohydrate protects protein as completely as a diet composed entirely of earbohydrate

Winle carbohy drate cannot replace the protein required for the growth and repair of the cells of the bods, it is probably necessary for the forma

tion of the perfect protein molecule

Uses of Fat — I at constitutes an important source of energy, and, like carbohydrate, is a spirit of protein. The fat of the food, when not needed immediately for oxidation, is deposited in the tissues of the body. The principal fat depots are the subcutaneous tissues, the liver, the perito-

grow and usually develop the eve drease

the occurrence of the eye
disease has also been noted umang children suffering from vitamin (A)

deficiency Block reports of the Danish children whose zerophthind in
vielded readily to diets rich in vitamin (A)

McCollum, Simmonds and
Parsons have attributed "inght blindness" an eve trouble in northern
regions to use of diets poor in vitamin (A)

may cause abnormalities and weaknesses other than the eve

Osborne
and Mendel refer to diarrher and diminished appetite, and McCollum and
Divis and Drummond to lung weakness.

Distribution of Vitamin (1)—It is quite widely distributed through out nature occurring in many of the animal fats such as butter fat and coll liver oil, but is generally lackin, in all vegetable oils. It is present in most of the leafs foods and in many roots such as carrots and sweet potatoes

Physical and Chemical Properties of Litamin (A)—It is a utility associated with fats and is soluble in the ordinary fat solvents. It is quite radily destroyed by oxidation such as sention at high temperature or ozone. It is not very rapidly destroyed at temperatures below 100. C and apparently withstands such treatment as cooking, canning and drying

Vitamin (B)—To Lukman and Hopl uss we must attribute the credit of calling attention to this unknown substance which Funk christened vitamin Berikeri a disease of the Orient where polished rice and fish are the principal foods has long been known. Eighman in 1897 was able to produce a similar condition an agreeous and found that by adding the rice polishings to the duet the sumptoms were relieved. The growth premoting substances demonstrated by Hopkans in milk and celled by McCollium water soluble (B) are probably identical with the anticupration substance which Funk called vitamin however there is some difference of opinion as to whether vitamin (B) is 3 unentity.

Effect of Lack of Vilamin (b)—In diets lacking in vitamin (B) toning animals cers, to grow become with and usually polyneuritic. In many leid to beriber: Mendel and Osborne and harr have demon strated the influence of vitamin (B) mon the appetite.

Occurrence of Vitamin (B) — In plints it appears relatively abundantly in leaves roots tubers seeds and fruits, and in animals in the glandular organs ergs and milk

Physical and Chemical Properties of Interna (B)—It is readily oluble in water and dilute deabel. It is more stable in acid than albalino olutions. Chick and Himme have found that it is little destroyed be two lours heating at 100. G, about one-hilf destroyed in forty minutes at 113° C and up to nuncteaths destroyed in two lours at 118° to 124° C. From these results little destruction should occur in ordinary cooking but

time furnishing acidity or alkalinity to the digestive juices. They also influence the olvent power and o motic pressure of the blood and tissue flinds.

A man under average conditions exerctes from 20 to 30 grams of inneral salts per day

#### THE LITTMISS

Studies in mitrition in recent veurs have firmly established that the food factors known as vitanima are indepensible for the welfare of the animal organism. It is only within the last ten or fiften years that we have realized that chemical analyses of foods for proteins, earbohydrates and minerals are insufficient to reveal their biologic value. Formerly a food was considered sufficient for mitritic requirements of the body if it fulfilled certain established standards as to total digestibility, available energy and proteins. Today, in addition to the above requirements of certain established section to the above requirement.

Hopkins was the first to demostrate clearly that normal nutrition requires other food substances than proteins, exholadates, fats and minerals. The name virtumine was given to these substances by Casuaer Finak in connection with his work on beribert. McCollum and Kennedy suggested that we call them fat soluble (1), water soluble (B), to which was soon added water soluble (C). Drummond has simplified the terminology by proposing that we drop the final e and retain virtumin as a group name and u e letters for distingua hing the various known members until chemical names are justified. Hence according to Drummond the shall be called virtumin (A), (B), (C) (D), etc. This later terminology has been quite generally accepted and will be used in the following descussion.

Our knowledge of vitamins is still in the 'making' and our present concept may be wholly changed in the conning years. At present we know of three vitamins with quite strong evidence of a fourth. The chemical

constitution of all is still unsolved.

Vitamin (A)—Hopkins in 1906, found that young mee, fuled to grow upon a mixture of purified proteins, carbohydrates, fats and sults, while the addition of milk or the alcoholic extract of milk rendered such a diet adequate for normal mitration and growth. McCollum and Divis, and Osborne and Mendel independently discovered that young rats grew or failed to grow depending whether the diet contained butter or lard This gave evidence of some fat soluble substance in butter fat which promoted growth. Inter Osborne and Mendel found that rits suffering from lack of vitamin (A) developed a peculiar eye discuss called "exceptibilitims".

Effect of Lack of Vitamin (A) - Young animals at least cease to

Vtm (C)

In order to include vitamins in our diets, it becomes necessary to how how to choose such a diet. Certain approximations of the vitamin content of foods have been made and may be used as a limited guide in selecting vitamin diets. The following table has been copied from The 1 tamin Manual and acknowledgment is bereby given 1

VITAMIN CONTENT OF FOODS*

Vtm (B)

CI

t Fodt#

Fats and oils Butter Cream Cod liver oil Mutton and beef fat or suet Lard Olive oil	+++ ++ +++ ++	0 0 0	
Cream Cod liver oil Mutton and beef fat or suct Lard Olive oil	++ +++ ++ 0	0	
Cod liver oil Mutton and beef fat or suet Lard Olive oil	+++ ++ 0		
Mutton and beef fat or suet Lard Ohve oil	++	0	
Lard Ohve oil	0		
Olive oil			i .
			l
	0		l
Cottonseed oil	0		1
Coconut oil	0		ł
Cocoa butter	0		
Lansced oil	0		
Fish oil whale oil herring			
orl etc	++		
Hardened fata (hydro			
geneted) of animal or vege			
tal le origin			1
	In proportion		
	to animal fat	i	
	used		
Margarin from vegetable fat			
or lard	0		
Nut butters	+		
i			
Meat fish etc	1		
Lean meat (beef mutton			
etc)	+	+	++
I iver	++	++	+
Kidneys	++	+	
Heart	++	+	
Brain	+	++	
Sweetbreads	+	++	
Fish white	0	Very slight	
T 1 4		af any	
Fi h fat (salmon herring			
etc)	++	Very slight	
Fish roc		if any	
Tinned meats	+	++	
Timed ments	1	Very slight	0

ing it may be very nearly all lost by extraction if the cooking water is rejected

Vitamin (O)—Scurry has long leen attributed to a faulty diet. Hotel and I robited found that guinea pigs readily developed scurrylike symptoms when fed on a certal or bread diet. These workers found that the introduction of fresh carrots or cabbrig would readily cure the disca elemidate. These concluded that scurry is caused by a link of a chemical substance from the scorbutte diety, and further demonstrated that it was easily destroyed by cooking or druing. That survey is a deficiency of vitamin (C) has been affirmed by Hess. Cohen and Mendel and others

Fflect of Lack of 1 thmm (C)—The lack of vitamin (C) causes the development of seurce loth in young and adult. The discase is characterized by swollen and blieding guins, lee ening of the treth, and characteristic legions of the microix membranes.

Distribution of 1 damin (c) —Among the vegetable foods, fruits and succellent vegetables, such as oranges, bemore, countoes and fire h cabhage, are the best sources. In the animal products it is present in milk and small quantities in meet

Physical and Chemical Properlies of 1 stamm (C)—It is readily water soluble, and more stable in neighbour allows solutions. It is quite readily destroyed by heat oxidation and drying. I rum studies made on its stability it is found that less of its potency is lost in licating at a link temperature for a short time than the revire. This is important in the matter of dried milk. Hart, Steenbock and Smith have found that dried milk made by the drimin process is retains considerable antiscorbutic value, while that made by the spray process is of much less potence.

Vitamin (D)—Recently strong evidence is being firmished that we have a fourth member of the interesting vitamin family vitamin (D), which is intrinstely comeeted with the calcufaction of lone. Hers in his studies upon infantile rickets has demonstrated that cod liver oil is almost a specific for rickets. McColhim, Simmonds Shipley and Park pre ent very substantial evidence of an antirichite vitamin present in cod liver oil which is destruct from vitamin (A). So fir this vitamin seems to be limited to the fiel liver oils such as cod liver oil.

Selection of Vitamus Diets—There is no reson to suppose that the vitamin needs of the body cannot be supplied by use of our widespread natural foods. Many widely advertised products have appeared on the market, claiming special virtue in their vitamin content. Bulley at the Connecticut Agricultural F speciment Station has biologically an ulvad a number of these commercial vitamin compounds, using as a standard dried brewer's yeast. When analyzed on this bisis, approximately 50 per cent of the advertised compounds showed inferior vitamin content. A few showed about an equal potency and only two or three of the products studied showed a greater potency than year.

VITAMIN CONTENT OF FOODS* (continued)

Cl f F ed tuff	Vtmn (A)	Itma (B)	V tamin (C)
Vegetable and fruits—Cont Lime juice fresh Lime juice preserved Orange juice fresh Raspberries Apples			++ Very slight +++ ++
Bananas	+	+	Very slight
Tomatoes canned Nuts	+	++	++-
Miscellaneous Yeast dried Yea t extract and autolyzed Meat extract Malt extract Beer Honey	† † 0	+++ +++ 0 + in some stecimens 0 +	0
Mest  Beef heart  Brans  Coddish  Codtestes Fish roe  Herring  Korse meat  Kulney  Lean muscle  Liver  Panceas Fig Beart  Thymus aweetbreads	+++++++++++++++++++++++++++++++++++++++	+++ +++ +++ +++ 0 +++ +++	1 +1 1 1 1 +1 +1 +1 0
Vecetables Beet root Beet root puce Cabbage druct Cabbage druct Cabbage fresh Carrota Cauliflower Chard Dasheens Lettuce Manuels Onions Parsinp Teas fresh	+	+ Lattle ++++ ++++ ++++ ++++++++++++++++++++	++++ ++++ ++++++++++++++++++++++++++++

+++1 di tes ab d t ++ relati ly large + p se t in small m t 0 ab t

		,,	
Clase f F d tuffs	Vitamin (A)	Mamin (B)	Vitami (C)
Milk cheese etc Alilk cows whole raw Milk cows skim Milk cows dried whole Milk cows boiled whole	++ 0 Less than ++ f	+ +	+ + Less than + Less than +
Nilk cows condensed sweet ened Chec c whole milk	+ +	+	Los than
Chee c skim milk Fggs fresh Fggs dried	0 ++ ++	+++ +++	01
Cercals pules etc Wheat marke rice (whole germ) Wheat mirke rice germ Wheat mirke rice bran White wheat flour pure corn flour polished rice etc Custard powders egg substi- tute prepared from excal	+ ++ 0	+ +++ ++ 0	0
products I in eed millet Dried peas lentils ete I ea flour kilned Soy beans harteet beans Germinated pul es or cereals	0 ++ + +	0 ++ ++ 0 ++ ++	0 0 0 ++
Vegetables and fruits Cabbage fresh raw Cabbage fre h cooked Cabbage dried Cabbage canned Swedes raw expressed juice Lettuce Spinach dried Carrots fresh raw Carrots dried	++ + ++ ++ ++ Very elight	+ + + + + +	+++ + Very slight Very slight +++ + Less than
Bectroot raw expressed juice Potatoes raw Potatoes cooked Beans fresh scarlet runners raw Lemon juice fresh Lemon juice preserved	+	+	++++

VITAMIN CONTENT OF FOODS* (continued)

THAT COLLEGE AS SOUR COMMENTS					
F d tuff	Ttm (A)	Vin (B)	V t m (C)		
Oils and fats					
Almond oil	0	0			
Beef fat	+	0	0		
Butter	++++	0	0		
Coconut oil	0	0	0		
Cod liver oil	++++	0	0		
Corn oil	0	0	0		
Cotton seed oil	0 1	0	0		
Egg yolk fat	++++	0	0		
Fish oils	++	l o	[ 0		
Lard	0 1	0	0		
Oleo animal	+	0	0		
Oleo venetable	٥	0	0		
Olive oil	lò	0	t o		
Pork fat	0.1	0	i		
Tallow	0	0	0		
Vegetable oils	0 1	0	0		
Nuts	}		1		
Almond	; +	+++	1		
Brazil nut	l	+++	l		
Chestnut	++	+++			
Coconut	++	+++	1		
English walnut	1	+++	1		
Filbert	Ι.	T +++	١,		
Hickory	l t	\ I	† †		
Pine	+	T .	, T		
Dairy products	1	1	1		
Butter	++++	0	0		
Cheese	++	+	1		
Condensed milk	++	+	0		
Cream	+++	<u>+</u>	1		
Fggs	++++	++	.0		
Milk powder skim	+	+++	+1		
Milk powder whole	+++	+++	+ 1		
Milk whole	+++	+++	++		
Whey	+	+++	+		
Miscellaneous	l	I			
Alfalfa	+++	+++	1		
Blood		Varies with			
~		source			
Clover	+++	++++	1		
Honey		++	0		
Malt extract	0	0	0		
Nectar	.0.	,0,	0		
Timothy	++	+++			
Yeast, brewer's Yea t cakes	0	++++	0		
Yea t cakes Yea t extract	0	+++	0		
+ cu t extract	1 0	777	0		

## VITAMIN CONTENT OF FOODS* (continued)

F od tuff	Vitamin (A)	Vitamin (B)	Vitamin (C)
Vegetables—Cont Potatoes Potatoes sweet Putabaga Spinach	0 +++ +++	+++ ++ +++ +++	+++
Cerculs Barley Bread white Bread whole meal Maize	+ + { + In vellow }	+++ +1 +++	1 1
Oats Rice polished Rice whole grain Ryc Corn embryo Corn Kaffir Corn (see Muize)	OIn white	+++ 0 +++ +++ +++	0 0 0
Corn fore Mility Corn pollen Malt extract Wheat bran Wheat embryo Wheat endosperm Wheat kernel	0 0 ++ 0 +	+++ 0 +++ 0 +++	0 0 0
Other seeds Beans kidnry Beans navy Beans soy Cotton eed Flavseed Hemp seed Vallet seed	+ ++ ++ ++ ++	+++ +++ +++ +++ +++	0
Peanuts Peas dry Sunflower seeds	+ + 1 +	++	0
Fruits Apples Bananas Grapefruit Grape juice Crapes Limes Oranges Lears	0	++ + +++ + + + +++ ++ ++	++ ++ +++ + + + ++++ ++
Raisins Toinatoes	++	+ +++	++++
+++ indic tes abun tant ++	r mett ety i rge 4	gr sent in mail	m unt dab at

VITAMIN CONTENT OF FOODS* (continued)

VITAMIN CONTENT OF FOODS* (continued)						
F d tuff	Vinn (A)	V t mi (B)	Vtm (C)			
Oils and fats						
Almond oil	9	0				
Beef fat		0	0			
Butter	++++	0	0			
Coconut oil	0	0				
Cod liver oil	++++	0	0			
Corn oil	0	0	0			
Cotton seed oil	0.1	0	0			
Egg yolk fat	++++	0	0			
F15h 01ls	++	0	0			
Lard	0.1	0				
Oleo gnimal	+	0	0			
Oleo vegetable	0	o o	0			
Olive ail	0	0	, ,			
Pork fat	0.1	Ò	í .			
Tallow	0	0	0			
Vegetable oils	0,1	ľ				
Nuts		+++	į.			
Almond	, -	+++	1			
Brazil nut		+++				
Chestnut	++	+++	1			
Coconut English welnut	7.1	. ÷÷÷	ŀ			
Filbert	)	+++	i			
Hickory	+	' + '	+			
Pine Pine	i .	i i	+			
	· '	i i				
Dairy products		1 .	0			
Butter	++++	1 0	1 1			
Cheese	++	ΙŦ	1 6			
Condensed milk	+++	<del> </del>	l i			
Cream	++++	<b>1</b> + + +	i			
Eggs	++++	+++	+1			
Milk powder skim	+++	+++	+ +			
Milk powder whole Milk whole	+++	+++	++			
Whey	+	+++	I '∓'			
•			1			
Miscellaneous	+++	+++				
Alfalfa	777	Varies with	'			
Blood		source				
Clover	+++	++++				
Honey	TTT	++	1 0			
Malt extract	0	1 0	0			
Nectar	0	0	0			
Timothy	++	+++	1 "			
Yeast, brewer's	7,	++++	0			
Yeast cakes	1 6	++	0			
Yea t extract	ŏ	+++	ŏ			
- ca s tarract	1 "	1	V			

+++ I dient ab d t ++ relatively I go + prese tin m I m t 0 her !

Condiments - Under the general term, "accessory articles of diet," are classed the condiments flavors, and stimulants. These substances are added to our diets to increase their attrictiveness and palatalality, al though they may impart a certain amount of energy by their oxidation Some of these substances due to their increasing publishility, exert a so-called psychical stimulation which facilitates gastric secretion and thus materially aids in sustric due tion

Ganthier has divided condiments into the following classes (1) arematic, comprising vamilla anise, cinnamon, mitineg, and other essential oils, (2) peppers (3) the alhaceous condiments—garlie, mustard, etc., (4) acid condiments-vinegar, eitron, pickles, etc., (5) the salty condiments, such as table salt (6) the sugar condiment. Under the head of stimulants are included alcohol, ten, coffee, cocon, chocolate, and meat extracta

Alcohol - The exact value of alcohol as a food as somewhat uncertain. Experiments made on man however, clearly show that alcohol is burned up in the body. Its potential energy is transformed into kinetic energy, and therefore alcohol is considered as having food value. While it acts as a food sparer it may not be a describle food. Prior to its oxidation in the body alcohol may produce deleterious effects of various kinds, which counterbalance the gain from its oxidation

the presence of eaffein. This alkaloid has a diffratic action on the kidner

and ruses blood pre sure. Muscular energy is augmented and the sense of fatigue is di sipated by the use of these stimulants Cocoa - Chocolate made from cocoa by the addition of sugar and

Tea and Coffee - The stimulating effect of ter and coffee is due to

flavoring agents acts as a stimulant through its content of theobromia

It also contains fats carbohydrates and protein

Meat Fxtracts - In themselves the c extracts have very little food value. Their value lies in their content of mitrogenous extractives, many of which are stimulants. They all o call forth a conjous secretion of gastric juice and for this reason have been called secretogogues

#### ACID-LOPAING AND BASE FOLMING FOODS

The reaction of normal human blood is shightly alkaline, but this is

so slight that blood and protoplasm may be spoken of as neutral The processes of metabolism cause a continual production of acid

(carbonic, phosphoric, and sulphuric) which must be disposed of in order to maintain neutrality

The factors that are concerned in the maintenance of nentrality are

(1) carbonates, (2) phosphates, (3) ammonia (4) proteins

Henderson has worked out the various relationships of the different factors in the maintenance of neutrality under normal conditions

hydrogen ion concentration depends upon the ratio of  $\frac{H\ CO_3}{NaHCO_3}$ . The

mechanism of the munitenance of this ratio is too involved for detailed discussion here, and the reader is referred to other sources

The normal and production in man on mixed diets is taken eare of, in part at least, by the formation and exerction of soid phosphates. An increived activity of the urine usually means an increased ratio of primary phosphates to secondary phosphates but without any necessary increase of fixed alkah leaving the body. In the neutralization of sulphuric acid by phosphates eich molecule of sulphuric acid converts two molecules of secondary into primary phosphate. This surplus of acid phosphate must be excreted to maintain the normal equilibrium. The neutralization of sulphuric acid, formed in the metabolism of proteins by potassium or solutin eithoload for the blood may lead to a depletion of fixed alkali in the blood.

Formerly it was believed that ammonia was used for neutralization of each by the liver and tissues. Receuth I hewever Na had Benedict have demonstrated that ammonia does not exist in the blood except in traces, and that the kidney is the seat of ammonia formation. Under these erremneathers creds must be transported in the body in combination with fixed bises or proteins. Thus there may occur a loss of fixed slikali from the body when there is a more rapid introduction of acid radicals into the blood stream than the normal kidney can eliminate or can make ammonia to combine with them while eliminating. Thus when there is an abundance of strong acid to be neutralized unless made good by the bise, forming, elements of the final thereone of the blood. Hence there is a relationship among the sish liverevies of the blood. Hence there is a relationship among the ash constituents of the food in acid forming and base forming elements in the maintenance of neutrality of the body.

While a continuous excess of acid forming elements in the diet is probably not harmful, the decreased unic acid salvent power of acid unines is well known

Blatherwich has studied a considerable number of the foods, and found that foods with a preponderance of hase forming elements tended to decrease the acidity of the urme and to increa e its solvent power for urne and while a preponder use of send forming chiments tended to form a more acid while a preponder use of send forming chiments tended to form a more acid prime with a desire of user acid solvent power and a tendency toward a depletin of the alkali reserve

The following foods have been studied by Sherman and Gettler 3

Van Sigko and Coss ker Jo nol f l ol seal Ch n str 1917 xxx 89 347 401 1917 xxx 1 4 495 1918 xxxlu 71 1919 xxxuu 167 19 0 xli 567 1991 xliui 153 Sierman an I G tiler Journ l of Buologi al Chemi try 1919 xi 5 3

# ASH ANALYSES OF SHERMAN AND GETTLER EXCESS OF ACID-FORMING OR BASE FORMING FLEMENTS

### (Ficess leid or Base in Terms of Vormal Solutions) Per 100 G ...

Pr 100 C lories

	Per 10a G m		P r 100	C lories
A ti les of Food	A id	Bare	Aeld	B /a
Almonds		12.35		1.56
Apples	j	376	}	5.98
Asparagus	ļ	0.51	ſ	362
Bananas	1	5.6		5 62
Beans dried		23 57		6 92
Beans lima dried		41 65		12 08
Beets		1066	l	237
Cabbage	ì	4 34	ì	13 76
Carrots	ł	10 62	ļ.	23 91
Cauliflower	!	5 33	1	17 49
Celery	Ì	7.78		42 17
Cherry juice		140	i	1 ^'
Chestnuts		7 42		319
Corn sweet dried	J 9J	1 ''"	177	1 ***
Crackers	~ S1	1	10,	1
Current dried	31	597	100	185
Fel	9 69	] ""		100
Fggs	11 10		~ ,,	
Fee white	221		9.59	
Egg yolk	90.09	1 1	7.08	1
Fi h haddock	16 07	1	103	i
Fi h pike	21.82	J j		J
Lamons	1101	040		12 32
Lettuce		7 37		39 69
Meat beef lean	13 91	1 151	12 19	5.00
Ment chicken	1701		46 10	
Meat frog	1036			
Meat pork lean	11.67	ł i		
Meat rabbit	14 80	1		
Meat yeal	13 .2	1 1		
Meat veni on	15 83		1	
Milk cows	2000	2 37		3 44
Muskmelon	1	7.47		18 82
Oatmeal	12 93	1	3 23	
Oranges		5 61		1094
Peaches .	ſ	5 04	ſ	12 20
Peanuts	39	1 1	070	
Peas dried		707		198
Potatoes		7 19		8 63
Prunes	11 11	21.40		8 05
Radishes		287	1	9 79
Raisins		23 69	1	6 87
Raspberry juice		4 91		
Rice	81		3 35	
Turnips		2 63		6 86
Wheat entire	9 66		3 25	
Wheat flour	11 61	ř.	270	

#### TOTAL FOOD REQUIREMENTS

The body derives the energy required for the performance of its functions from the food the potential energy of the food being transformed into heat and work. Without some knowledge of the food requirements in health, it will be found difficult to arrange rational dictaires for patients. In health the appetite constitutes the charf guide to our needs and is in the many reliable. That it is not always so is evidenced by the various disorders from overmodipgence or underrollagence in food

Two methods have been employed to determine the daily food requirement of man the empirie and the experimental. The empiric method consists in studying the food habits of a large number of people in various occupations and taking the average quantities of food, and foodstuffs, con sumed by each class. The experimental method consists escapitally in measuring in terms of heat, the amount of energy produced by the body under different conditions as when at work at rest, and on different diets. Many important facts have been obtained from studies of metabolism carried out won the lower animals.

Our present knowledge concerning metabolism in man has been denived from both the empire and experimental methods. The results of the atudies base furni hed us with what are known as standard requirements. It should be pointed out however that these standards are not absolute, they are simply guides, which man and should, be varied according to the requirements of different individuals.

The total food requirement is generally expressed in calorics or heat units. The term calory unless qualified may mean either the amount of heat necessiry to ru e 1 gram of water from 0° to 1° C or 1000 grams of water from 0° to 1° C. They are designated respectively as small and large calories. Usually the distinction is made by using an initial capital for the large calory thus Calory means large calory. The term 'calory,' as ordinarily employed in medical literature, should be interpreted as large calor.

The body follows the general law of the conservation of energy, that is the energy yielded by the food which is actually absorbed and oxidized and which is manifested as heat of heat and mechanical work, corresponds with the potential energy of the different foodstuffs consumed. Therefore it is possible to calculate the tail value to the body of the different foodstuffs. Rubner's figures shown below are generally employed for the purpose.

1	gram	ot.	protein furni hes
1	gram	of	fat furnishes
1	gram	of	carbohy trate furnishes
			alcohol fuena les

⁴¹ calories 93

⁴¹ 70

The total energy requirement may be expressed as calories per kilogram per day or calories per square meter of bods surface per hour. The latter method is the more accurate, and the chart recently published be Du Bois and Du Bois mikes the method practicable for bedaide work (see Chart).

The total energy requirement of an adult at absolute rest (that is, without voluntary movement of any kind) and twelve hours or so after food is 22 to 20 colories per kilogram per day or 1, 40 to 1,820 calories for a min working 70 kilograms (154 lbs). The total energy require-

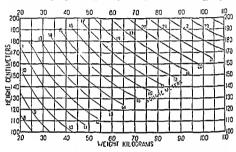


Fig. 1—Citast for Detrainistics Sugrace Art. or Max is Squar Mitters 1800 Mision is Micro axis and Different for Centimerism The point of Interaction of ordinate and about a f r any individual in found and the surface area real of it the curved lines. For example if a man is 150 centimeters in leght and wit be 60 kilograms. In approximate surface area will be 1.25 square meters. (After De Box and De Box a.)

ment by surface area is 79.7 culouse per square meter per hour Patients confined to bed are never at absolute rest, however, within the meaning of the term, except during sleep or when commose and the energy value of their food, except maker special conditions and for brief periods, should not be permitted to fill blow this manimum

A number of circumstances may modify the demand for energy Among the more unportant of these are the ance size of the individual, amount of muscular work, and di turbiaces of metabolism brought about by various diseases

Age —The rate of inclubolism varies with the 1.5c of the individual It is greatest in infancy and childhood and lowest in old age. As will

be seen on the chart (Chart 2) metabolism, which is low at birth, rises rapidly during the first yerr and reaches its maximum somewhere between the first and swith vears (this period has not been thoroughly investigated). Meer the sixth year it fills repidly until the age of twenty, and thereafter very slowly. There is no difference between the seves in infance. After the sixth year july and women have a distinctly lower metabolism. Dn Bois found the heat production of boxs, 12 to 13 years old, to be 25 per cent above the adult level. A surphis over the actual demand of the child should always be given to allow for growth.

Heubner states that the energy requirement of a child in the first three months of life is 100 Calories per kilogram of body weight per day,

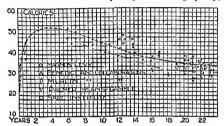


FIG *—CHART SHOWING VARIATION OF BASAL METABOLISM WITH ACC Calories per lour pe square mete of body surface Mech formula Dash line abows average for males, dotted line for (remake, After Du Boss)

in the second three months 90 Calories thereafter, 80 Calories and less per kilogrum The energy supply should not be allowed to full below 70 Calories per kilogram.

Size—In rener il persons of lurre frame and build require more food thun tho e who are small. The increase however corresponds to unit of warfac are rather than to weight. For this reason persons who are fat require relatively less food than those who are thin though a fat person expends more energy in the performance of muscular work because of the greeter effort required to move his body.

Muscular Work — The performance of mu cular work is accompanied by an increase in metabolism and a greater supply of food is demanded. The increase is chiefly at the expense of fat and carbohydrate though when they are not available protein may be consumed. Many investigations have shown the relation of muscular work to metabolism. The results can be best illustrated by the following table, arranged by Atwater

# FOOD CONSUMPTION OF PERSONS IN DIFFERENT CIRCUMSTANCES AND PROPOSED DISTARY STANDARDS **

#### (Quantities per man per day)

	A	et ally	Esten		Dige [[]	ile	Ι.,
Or up tions	G m Pro tein	Grem Fat	Gr m C rbo by d tra	O me 1 re	Grame F t	G ms C bo Ay d tes	Value Cal ri
I ersons with Active Work							-
Rowing clubs in New England	1 .	177	440	143	168	421	3 955
Bicyclists in New York	156	186	6.1	171	177	631	J 005
Football teams in Connecticut	!	l	l		•	'	1
and California	226	3.1	634	209	336	615	6 .90
Pru sian machinists	139	113	677	128	107	657	4.2.0
Swedish mechanics	159	110	714	174	104	693	4 590
Persons with Ordinary Work		1			-		l
Farmers families in ca tera		l				ì	1
United States	97	130	46"	89	124	4.3	3 415
Mechanics families in United							1
States	103	1.0	402	95	143	390	3,355
Laborers families in large							Ι΄.
cities of United States	101	116	344	93	110	334	2 810
Laborers families in United							_
States (more comfortable			1 .				Į.
erreumstances)	120	147	534	119	140	518	3975
Russian persants	129	33	559	119	31	571	3 165
Swedish mechanics	134	79	J23	123	7.	J07	3,330
Profe sional Men		1	1				
Lawyers teachers etc in					- 1		
United States	101	12.	423	96	119	410	3,200
College clubs in United State	107	148	4.9	98	141	445	3 5 0
Cerman physicians	131	95	327	121	90	317	9 650
Japanese professor	123	12	416	113	19	403	9 345
Men with Little or No Fxereise							
Men (American) in respira			l Į	- 1	- 1		
tion calorimeter	112	80	305	103	76	296	9 340
Men (German) in respiration				- 1	- 1		
apparatus	127	80	302	117	76	293	2 430
Persons in Destitute Circum	- 1		- 1	- 1	- 1	- 1	
stances	- 1		- 1	- !	- 1	- 1	
Poor families in New York		_ [		- 1	- 1	- 1	
City	93	9.,	407	86	90	395	2 845
Laborers families in Pitts	ا مما		900		I		
burg Pa	80 52	95	308	74	90	299	2 400
German laborers family	76	32	297 396	48	30	278	1 640
Italian mechanics	10	99	296	70	36	384	2,275
F t and c rbobydr t I m	1 nt a	m u ta	to furni	h toe	th r w	Ith the	n oteln

Ft and c rbohydrt I mint am u to furnin tog ther with the p otein the i dicated amount of hergy

FOOD CONSUMPTION OF PERSONS IN DIFFERENT CINCUMSTANCES AND PROPOSED DIFFARY STANDARDS (Continued)

		taslly l	t t		Dgetb	1	Ful
Оъры	G ==	G =	G m C b ky d t	G =	G m	G m C b by d t	C1
Muscellaneous	_			$\Box$	_		
Negro families in Alabama and			ļ.	1	1	i i	ļ ,
Virginia	86	14a	440	79	138	497	3 395
Italian families in Chicago	103	111	331	95	100	379	2 965
French Canadians in Chicago	119	158	345	109	150	35 ن	3 060
Bohemian families in Chicago	115	101	60	106	96	349	2 900
Inhabitants Java village Co		i .	l	1	1	1	1
lumbian Exposition 1893	65	19	%4	61	18	n46	1 450
Russian Jews in Chicago	13:	103	418	106	98	40ə	3 135
Mexican families in New				l			1
Mexico	94	11	613	81	61	595	3 400
Chinese denti t in California	11.	113	989	106	107	240	2 600
Chinese laundryman in Cali							
formia	130	76	Jbb	194	72	549	3 480
Chinese farm laborer in Cali	i	Ι.	١				
fornia	144	95	610	139	90	671	3 950
United States Army ration		l	١				i
peace	120	161	454	110	153	440	3 730
German army ration peace	114	39	450	105	3,	160	0 725
Dietary Standards	١		4.0	1			
Man at hard work (Voit)	145	100	500	133	95 53	497	320
Man at moderate work (Vost)	118	56	900	109	92	445	9 965
Man with very hard muscular		١.,	(a)	161			
work (Atnater)	1,	(a)	(4)	161	(a)	(a)	5 500
Man with hard muscular work	10	(g)	(a)	133	(a)	(a)	4 150
(Atwater)  Yan with moderately active		(2)	(2)	195	(a)	(a)	4 150
muscular work (Atwater)	12	(c)	(a)	115	(a)	(a)	3 400
Man with light to moderate		12)	(4)	1113	(4)	(4)	3 400
mu cular work (Atwater)	112	(1)	(a)	103	(a)	(a)	3 050
Man at sedintary or woman		(")	(4)	10,	(4)	(4)	9 030
with moderately active work				1			
(Atwater)	100	(a)	(a)	93	(a)	(a)	9 700
Woman at light to moderate		1 "	(-,	1 "	(4)	(4)	. 100
muscular work or man with	i			[			
out mu cular exercise (At	1						
water)	90	(a)	(a)	8	(a)	(a)	9 450

The energy requirement of adults reduced to calories per kilogram of bods weight mas be manarized in the following table (von `\oorden) In general a min at nearly complete rest requires on the average one calorie per kilogram per bour

#### CALORIES PER KILOCRAM PER DAY

Absolute rest	24 30
Ordinary rest in bed	30 34
Out of bed without work	34-40
Moderate work	40-45
Hard work	45 60

#### PROTEIN, PAT, AND CARBOHADMATE RATIOS

The relative proportions of protein, fat, and carbohydrate which should enter into the diet must be considered, as well as the total food requirement

Protein Requirement —The dult protein requirement is an important question in nutrition and has been the subject of much discussion. The optimum protein ration has not yet been determined. It probably varies with different individuals and under different conditions, such as external temperature, amount of work done, etc.

It has been a sumed that a healthy man under normal conditions would consume daily the amount of protein which he has found by experience to be suited to his needs. The almost universal support which has been accorded to Voit's recommendation, until recently, is essentially a recognition of this assumption. Inter-studying the food liabits of a large num her of people Voit placed the daily protein requirement of a man at light work at 118 grams. Atwater employing the same method, found the requirement to be 120 grams a day. But within the last fifteen years or so the correctness of the Voit and Atwater standards has been called into question, largely on the basis of experimental as contrasted with statistical studies. Probabily the most important of these increagations has been carried ont by Chittenden. He believes 'that the Voit and Atwater standards call for amounts of protein food far beyond the requirements of the load.

that the need for protein food may be fully met hy a duily metabolism equal to an exchange of 0.12 grims of it per kilogram of body weight? For a man of 70 kilograms (1.4 pounds), this repre ents 60 grains of protein a day, which is about one-half the Voit and le s than half the Viviater standards. Chittendens investigations were carried out on processional men, students, and soldiers. The case of Professor Chittenden himself, suffering as he had for years from "rheumatism," "bihous at tacks," and sick headaches falls rather into the category of disease with possible disorders of digestion or metabolism, so that an excess of protein over his minimal needs acted injuriously.

It will be assumed in the discussion of the daily protein requirement that fat and carbohydrate are supplied in sufficient amounts

More recently Chittenden has employed the statistical method on 108 healthy persons selected at random and he states that as a group they represented the average type of vigorous manhood common to most university centers. They metabolized on an average 0.13 grain of introgen per halogram of body weight as contrasted with the 0.22 grain of the Voit standard. There is, therefore close correspondence between Chit tenden's experimental and statistical results. The statistical observations especially raise the question whether there may not be many per one whose daily protein requirement is entirely satisfied by appreciably less protein food than is called for by the Voit and Atwater standards.

Chittenden's views have met with vigorous opposition. It has been pointed out that the most progre vive races of manhind consume protein in quintities approximating, the Voit and Iwater standards. Benedict cites the poor whites and negrous of the South as examples of the deleterious effect of the low protein dut. Nicefore calls ittuition to the sociological sixtus of the laborers of southern Italy, and thinks it due to the small amount of protein in their dut. McCav has shown that the Bengalis who are inferior in physical development to the Inglo-Indians, and Eurasians mutabolize only about 7 grams of protein a day, or 0.11 gram nitrogen per kilogram of body weight. But it cannot yet be assumed that the relation of cause and effect in these cases has been established.

Experiments upon the lower animals indicate that the injurious effects of a low protein diet may not mainfest themselves for a year or more, and while it does not necessarily follow that similar injurious efficies may be caused in man vet the experiments suggest the need for caution in accepting Chittenden's conclusions. According to Task, there appears to be no strongly substantiated argument why that portion of mankind living in a cool climate should not follow the general custom of taking a medium amount of protein in moderate accordance with the dictates of their spiritities.

Only a limited number of investigations into the protein requirement in disease have been made and an attempt to state the requirement for different diseases would not be justified. Therefore until the daily protein requirement both in health and disease is more definitely determined the wire et course for physicians and others, who have control of dietaries appears to be to follow the older standards or at least to permit persons to gritify their disire for protein food.

Tarations in the Protein Requirement—The demand for protein vivies within much narrower limits than the demands for fit and carbohydrate. An excess of protein is needed during the period of growth and seconding to Lusk, during training to provide for the accompanying hypertrophy of the mu cls.

The demand appears to vary also with different persons of the ame sociological status. It is a matter of common observation that some per

sons eat more ment then others, and claim that their efficiency is impaired if their usual supply is diminished. Old people, as a rule, take less protein than those in active, middle life.

Though protein is not concerned directly in the production of energy for muscular work, provided the fat-carbohydrate supply is sufficient, a greater amount of protein is allowed by both the Voit and Atwater stand ands for occupations entialing physical exertion. An entirely satisfactory explanation of the increased demand has been offered. Voit assumed that muscles engaged in active work must have a free supply of protein quickly available. Magnus Levy thinks that the increased consumption of protein is not the result of purpo that selection, but is incidental to the increase in the total food.

The inclination to diminish the amount of protein in hot weather and hold changes is general and finds its explanation in the high specific dynamic action of protein, that is, the high proportion of potential energy which is hierarch as free heat and which does not take part in the vital activities of the cells.

Our knowledge of the protein requirement in pathological states is very incomplete. I arge amounts of protein are often taken in dialetes mellitus and exophthalium gonter. The bld is accurant that an excess of protein is required during convalescence from the acute infective diseases because of the febrile destruction of protein which occurs, but there is reson to quistion whether an excess is required, if, during the cour of these dit called a call

Injurious I fleets of an I xeess of Protein — The body does not posses, to any marked degree, the power of storing, introguous substances. The carbonaceous moiety of the protein molecule is split off and the excess of introgen is quickly climinated, clinelly as urea. It has been stated that the interested work thus demanded of the kalmy sawould damage them, but proof of the statement is lacking. An excess of protein in the dut frequently causes disturbances of ingestion, which may or may not be referred subjectively to the alumentary tract. It appears probable that products of protein patterfaction may be absorbed and irritate the kalmess in their climination producing albuminium, and prings introducing of protein digestion or includeling albuminium, and prings alternal selections of metabolism or both—at least, persistent he adactics which are not due to any other discoverable cause sometimes disappear when the protein ration is reduced to a minimum and the form of the protein schouged, for example, from meat to milk. Professor Cultiedden found that his rheumatism grew better under the influence of a low protein det. Some forms of eczemi disappear when meat is eliminated from the diet, and the toth protein of the food is reduced (Joinston). It has not yet been proved whether an excess of protein is capable of causing acterial sektrosis.

The Garbohydrate Fat Requirement—The greater portion of the energy of the body is derived from carbohydrate and fat Since they are to a large extent interchangeable in the diet, they may be considered together. While it is possible for men to live and to thrive, upon a diet of protein and fat alone, as in the case, of the Eshims, or of protein and carbohydrate alone, physiologic economy makes it expedient that the diet should contain both fat and carbohydrate. In a mixed diet carbo hydrate and fat possess about equal power as a protein sparers. As already stated, Landergren has shown that a diet furnishing half of its calories as fat and half as carbohydrate has the same power as a protein sparer as a diet of carbohydrate alone. As a source of energy, therefore, in a mixed diet carbohydrate and fat are interchangeable in isodynamic amounts.

The relative proportions of fat and earbohydrate in the average diet are given in the Voit and Rubeer* standurds. But the proportions vary secording to personal taste and the ablity of the individual to digest fat Large amounts of fat in a mixed dict are difficult to digest due as Pav low has shown to the inhibiting influence which fat exerts upon the gastric secretion.

The conditions which affect the carbohydrate-fat demand in health arcesentially the same as those which modify the total requirement of energy and have already been considered under the Total Food Requirement. It may be added however that the amount of fat consumed is generally less in hot climates and in hot weather. The revsoin poularly assigned is that fat is 'beating' Rubner has shown that a greater amount of froe theat is thersted during the metabolism of fat than during the metabolism of carbohydrates. Physicians generally advise patients who are taking fat medicinally for example cod liver oil to discontinuo it in hot weather Aegroes form an exception to the rule that peoples thying in farm chamtes eat little fat. They enjoy and consume fat in relatively large quantities.

Too little is known concerning the fat requirement in verious diseases to justify specific recommendations. The fat in the foot is increased when it is desired to have a patient put on flesh. Fat appears to pose as along with earbohydates, the power of diminishing the febrile destruction of protein.

The Injurious Effects of an Excess of Fat —The tolerance for fat, both as regards quantity and kind varies in health. Van persons cannot take much fat or certain fats without experiencing a feeling of disguist which may amount to manes. In addition fat is capable of producing certain well-ifeined local disturbances of the abmentary tract.

See Tile npge 9

The phras access of fat must be und retood to relate to the tolerance of the ide dual rather then to the total amount of fat con used

sons eat more meat than others, and claim that their efficiency is impaired if their usual supply is diminished. Old people, as a rule, take less protein than those in active middle life.

Though protein is not concerned directly in the production of energy for insendar work provided the fat-carbohidrate supply is sufficient, a greater amount of protein is allowed by both the Voit and Atwares stand ands for occupations entailing physical evertion. No entirely estisfactory explanation of the incressed demand has been offered. Voit assumed that muscles engaged in active work must have a free supply of protein quickly available. Magnis Levy thinks that the increased consumption of protein is not the result of purpo thil selection, but is incidental to the increase in the total food.

The inclination to diminish the amount of protein in hot weather and hot climites is gueral and finds its explanation in the high specific dynamic action of protein that is the high proportion of potential energy which is liberated as free heat and which does not take part in the vital netwrites of the cells.

Our knowledge of the protein requirement in pathological states is very incomplete. I arge amounts of protein are often taken in illustrational working the content of the content in required during convalescence from the acute infective in cases because of the febrile destruction of protein which occurs, but there is reason to question whether an excess is required, if, during the course of these diseases, adequate simplies of earlichydrate and fat are furnished

Injurious I flects of an I xcess of Protein -The body does not po es, to any marked degree, the power of storing mitrogenous sub timees The earbonaceous motets of the protein molecule is split off and the excess of nitrogen is quickly eliminated chiefly as urea. It has been stited that the increased work thus demanded of the kidness would damage them but proof of the statement is lacking. An exects of protein in the diet frequently causes disturbances of digestion, which may or may not be referred subjectively to the alimentary tract. It appears probable that products of protein patrefaction may be absorbed and irritate the kidneys in their elimination, producing albuminuria, and perhaps ultimately caus ing nephritis Some headaches appear to be caused by disorders of pro-tein digestion or metabolism or both—at least, persistent he idaches which are not due to any other discoverable cause sometimes disappear when the protein ration is reduced to a minimum and the form of the protem is changed, for example, from meat to milk Professor Chittenden found that his rheumatism grew better under the influence of a low protein diet. Some forms of eczema disappear when ment is eliminated from the diet, and the total protein of the food is reduced (Johnston) It has not yet been proved whether an excess of protein is capable of causing arterial selerosis

The generally accepted ratios of protein, carbohydrate, and fat for per son at light, moderately hard, and hard work are contained in the following table

STANDARD RATIONS

	1 :	R b	Ata te
Light Work			
Protein grams		193	100
Fat grams		46	*
Carbohydrate grams		3.7	. *
Calories		2 41.	2 700
Moderately Hard Work		1	[
Protein grams	118	127	125
Fat grams	56	2	
Carbohydrate grams	00	09	
Calories	3 05.	2 9 6 9	3 400
Hard Work			1
1 rotem grams	14	165	1.0
Fat grams	100	70	
Carbohydrate grams	00	560	
Caloriea	35,4	3 300	4 150

Fat ad rb hyd t me tb pt li d l um i t quantities to m ke up the h cessary

It must be pointed out that these figures represent ageriges obtained by calculations from a maintain of tool actually catten by a group of individuals. Such figures will of curse allow for certain individual fluctuations on either side of the interac. figures which however, as a generi measure may be accepted with considerable confidence.

Method of Reckoning the Protein Fat and Carbohydrate Ratios for Diets of Definite Energy Values—In Youts studied duet for a min at moderately hard work, approximately 16 per cent of the energy 18 furnished by protein 18 per cent by fut and 66 per cent by carbohydrate With the total energy value of the duet as 3 909 calories the calculation is made as follows:

16 per cent of 3 000 = 
$$\frac{480}{41}$$
 = 115 grams protein

66 per cent of 
$$3600 = \frac{1990}{41} = 483$$
 grams carbohydrate.

By the employment of this method, the ratios may be determined for diets of any given energy value which may be confined to the stomach or to the intestines. The commoner disorders are loss of appetite, naises after taking fool, and somiting. The ceffects are probably due to the inhibitory action of fat upon the gastrie secretion or to the delay which it causes in the presage of the chyme into the diadeduum. Regurgitation of the diadedual contents into the stomach sometimes occurs and is usually followed by vomiting. An excess of fat often consess duarrher.

Besides these both actions, an ever sof fat is behaved by many author ties to cause di orders of metabolism. Persons otherwise in perfect heithi sometimes develop aem when the food contains much fat, but whether this re ults from a disturbance of metabolism, or of digestion, is not known.

It has been isserted that an excess of fat is of itself capible of caus in acidosis, but such a general is section must be accepted with reserve Deprivation of cardiohydrit is followed by acidosis in disease as well as in health because of the mere seed demand for energy which falls upon fat, and its consequent incomplete combination. Acidosis of this character has been observed to disapper is pointaineously, and always disappears in health per one upon the addition of carbohydrate to the diet, as sufficient cirbohydrate precurs the formation of ketone bodies. The influence of starvation upon the development of acidosis has sometimes been overlooked and the condition has been attributed erroneously to the fat of the food or to the effect of the disa or itself. For example, doubt his been est upon the causetive relation of fat to the "evelic vounting of children. Magnus-Leva has pointed out that the cause of acidosis in dialectes mellitus is not the fat of the food, but the preceding in order of metabolism. Lat in amounts up to 250 grains a day does not cause acidosis in typhoil fever.

Czerny and Stemitz believe that the majority of cases of acidosis in children are due to an exicas of fat. In experiments made upon children by Czerny and Lidler, fat was the only foodstuff which in crev cd the ammonia exerction in the urine. Stemitz has advinced the theory that the development of acidosis with fatty and stools in the gastrontestinal disorders of children especially the chronic forms, is due to the loss of fixed all, his through the intestines either in their own form or in combination with fatty acids that is, such as soaps. Buildr considers that the increve c of alkali in the stools is due to the stimulating influence of fat upon the purcers and the intestinal scretions, that there is not rough fatty acid present to account for all of the bises. According to Fraind there are but few tenable arguments and no absolutely certain metabolic-chemical facts to support the clinical impression of a causative relation between fat and acidosis. Let for the present it seems advisable to be guided by clinical experience, and to withhold fat, or give it with cuttion, in the faster intestinal disorders of clulteren.

1			1	₹,1	Full	100 C le *
	P C 1 P 1 (N 6 5)	PCI	P C t	Pund	0 100 G ms	P '
F d Mate 1s	P (N 6 5)	f Fit	hyd t	P und	G ms	in "
	(,, ,,)		.,	e ı n	C 1	G″m
Animal Food-Cont	ì				ļ.	l
Pork Fresh		- 1				
Chops medium fat	140-190	3.0-3.0		1 .80	350	28 6
Chone fat	11 0-19 0	39 0-49 0		9140	4.0	216
Ham smoked lean	190-900	170-740	1	1.245	280	3.7
Ham smoked medium						
	19 0 3 0	200-458		1940	4.0	23 6
fat	120-190			9 48	200	18 2
Ham amoked, fat		39.6		194	430	23 6
Ham amoked average	165					149
Bacon medium fat	60180	J7 0 R0 0		3 000	670	149
Sausages	/ 1					1
Bologna	150-210	110-210	00-00	1 095	240	41 "
Frank fort	15 0-27 0	350-260	90-86	1 170	960	38.5
	150 510	290 10	00-86	9 125	470	21 6
Pork	1 4 0 Fac	25000.0	00-00	120	310	} "
Poultry etc Fresh	1					١
Chicken broilers	19 0-05 0	°0 40		50a	110	911
Fowls	150-920	100-480		1 045	230	43.
Turker	19 0-25 0	90-310		1,360	300	33.4
Chicken liver	22 4	43	24	640	140	714
					1	1
Fish Fresh				4.	100	100 0
Basa black average	206	17				
Bass striped average	186	9.8		465	105	95 2
Bluefish	194	12		410	91	109 9
Corl	15 0-18 0	03-05		320	7.3	138 9
Halibut steaks average	186	50	t .	762	125	800
Mackerel	17 0-19 0		ì	64	140	714
Salmon average	2.0	1.8	1	9.0	210	477
Salmon average	188	9.	l	750	185	606
Shad average	209	38	26	600	135	741
Shad roe	1	, ,,	1	1 000	100	1,57
Fih Prescryed and	đ <u>i</u>	1		ı	ı	1
Canned	1	1	1	1	1	١.
Cod salt housele:	₅ 1	1	ļ		1	1
average	673	0.3	1	490	110	909
Ma kerel salt boneles	.1	1			1	1
average	173	964	l	1435	300	31 2
Sardines	23 0	197		1.260	250	3.7
Cariere	300	197	(	1 -30	340	29 4
	1 000	1			1 010	
Shellfish etc Frc h	1		10-00	n40	53	189 0
Clams	80-96	7 10-14	100	1 140		
Lobsters	}1 0—0 1		00-10			1162
Oy ters	4 0-10				53	1972
Scallop average	148	01	34	345		131 5
Crabs	166	20	1.9	415	92	108 8
Meats Cooked	1	[	1	9		1
Reef ronst	1 . 0_99	0 00 0-41	k	1000	360	278
Reef round stea		~ ~ ~ · · ·	1	1 - "	1	1
ros ted	1100-1	0 30-17	ol .	840	195	541
ron ted	1200-1	-1 . 3-40	1	1 040	1 10	1017

#### COMPOSITION OF FOODS

Slightly modified from Atuater and Bryant U S Dept Agriculture
Bult No 28 (recised edition)

Food M ta inis	P Ce t Protein (\ 6 5)	Pe Cent	PrCent	Pi Natue Per Pd	Fuel \ 1 per 100 G ama Cal rie	C to p
Anunal Food	1			1	,	-
Beef Fresh	í	•	ſ	1		1
Lon kan T.P.*	130-940	11 0-15 0	ł	900	199	52 5
Lon medium fot		160-240	l	1 190	262	38 2
Loin fat		2.0-700	i i	1 490	379	304
Loin average	100	191		1100	2.4	39 4
Loin porterhouse steal	210	204	1	1.270	270	37 0
Loin sirloin steak	180	19.	1	1 130	2.,0	400
Loin tenderloin		17 0-30 0		1 330	290	345
Ribs lean	1100-210	10 0-14 0	1	8,0	190	226
Ribs medium fat		180-330	ľ	14,0	320	31.2
Ribs fat		310-370		1780	390	25 5
Ribs average	17.8	246		1 370	300	33 4
Rump lean		10 0-18 0	-	00.4	210	47.6
Rump medium fat	160-120	20 0 - 30 0		1 400	310	323
Rump fat		30-390	1	1520	400	250
Rump average	187	231		1,370	290	34 5
Beef liver	18 0-23 0		10-3-	CO3	130	740
Beef marrow	22	0.8	-	3000	870	11.5
Beef tongue	170-220	10-180		740	10.	60 6
	3					
Veal Fresh	900-930	10- 60			100	800
Leg lean		70-120		20		606
Leg medium fat	190-210			615	165 135	741
Loin lean	180-200			825	180	9 14.1
Loin medium fat	18 0-19 0			1 144	250	400
Loin fat	199	100		790	175	57 2
Loin average	200-290			C40	140	714
Rib medium fat	160-200			1 160	200	39.4
Rib fat	169	64		J95	130	77 0
Veal kidney average	190	53	1	373	125	80.0
Veal liver average	150			3,3	123	000
Lamb Fresh	}					
Leg	15 0-18 0			1,00	290	34 5
Loin	170-200	25 0—35 V	1	1 40	340	294
Mutton Fresh	1 !	. ,			,	
Leg lean	190-000	190-130	i	890	195	513
Leg medium fat	17 0-10 0		I	110.	-40	417
Leg average	187	17 -		1 095	240	417
I orn medium fat	14 0-20 0		- 1	1 695	375	267
I om free fat removed	237	185	- 1	1 925	270	370
Lidney	16	32	}	440		1030
Inver average	§ 231	90	50	90.	200	500

Edible Portion

				· · · · · ·		
F dM terlal	P C nt P t (N 825)	P C t	PCt Cb lyd te	Pou 4	F 1 F 1 F 100 G m	100 C 4 1 P t us G m
Animal Food—Cont Pork Fresh						
	140190	2 0-35 0		1 590	3a0	28 6
Chops fat		39 0-49 0		9 145	470	21.6
Ham smoked lean	19 020 0	140240		1 245	280	357
Ham smoked medium						١
fat		300-4-0		1 940	430	23 6
Ham smoked fat		4° 057 0 39 8	i l	1940	₩00 1 0	18 2 23 6
Ham smoked average Bacon medium fat	16.0	5~ 060 0		3 030	670	149
	00-100	3 0-000	1	0 000	810	14.9
Sausages Bologna	150 010	110-210	02 0-	1.00	240	417
Frankfort		1 0 - 960			200	39 5
Pork		50-510			4,0	21 6
Poultry etc Fresh						
Chicken broilers	190 50	0 40		μ0a	110	911
Fowla		100-280		1040	230	43.
Turkey		90-310	1 1	1 360	300	33 4
Chicken liver	274	40	24	640	140	714
Fi h Fresh	1	1				ŀ
Base black average	206	17	1	45ء	100	100 0
Base striped average	18 6	28		465	105	95 2
Bluefish	19 4	12		410	91	109 9
Cod	15 0-18 0		, ,	375		138 9
Halibut steaks average	18 6	5 %		აცი	105	800
Mackerel Salmon average	17 019 0 22 0	1 8		64 950	140 210	714
Shad average	188	95		750	165	606
Shad roe	20 9	38	9.6	600	1 5	711
Fish Preserved and					1	1 1 - 1
Cannel	1					
Cod salt boneless	1	1 1	1			ì
average	273	03	[ i	490	110	909
Mackerel and boneless						
average	17.3	% 4		1 435	300	31 2
Sardines	930	197	]	1,260	290	35 7
Caviare	30 0	197		1 530	340	29 4
Shellfi h etc. Fresh	۱., .,	10 1.9	40 00			
Lobsters		10- 20			-3	189 0
Oysters	40-100		00- 70	935	86	116 2 190.2
Scallops average	148	01	34	34.	76	131 5
Crabe	16 €	00	12	415	92	108 6
Meats Cocked		1				
B of roast	150-090	000-410		1670	360	278
Beef round steak						
roasted	10 0-34 0	30-1"0	1	840	185	54 1

#### Composition of Loods

Slightly modified from Atwater and Bryant U S Dept Agriculture Bull No 28 (recused edition)

F d Mat 1 le	Per C nt Prot (\ x 0 5)	Per C ut	Per C 1	F 1 lue per d	Fu 1 1 1 e per 100	100 C   17
	ı		hydr tes	C I	Grams In C 1 es	C in
Beef Fresh	i			l		l
Loin lean F.P.	13 0-94 0	11 0-1.0		900	199	295
		100-210		1 190	262	38 9
Loin medium fat		2 0-300		1 490	329	30 4
	190	191	i	1100	2.4	39 4
Loin average		204		1 270	270	3.0
Loin porterhouse steak		195		1 130	250	400
Loin sirloin steak	189	170-00	l	1330	290	34 5
Loin tenderloin						576
Ribs lean		100-140		810	190	
Ribs medium fat		19 0-33 0	1	1450	370	31.2
Rib fat		34 0-37 0		1 780	390	256
Rib average	179	240		130	300	33 4
Rump lean		100-180		000	210	4"6
Rump medium fat		20 0-30 0		1 400	310	323
Rump fat		33 039 0		1 990	400	950
Rump average	197	23 1		1 325	290	34 5
Beef liver	18 0-23 0		10-35	60s	135	740
Beef marrow	22	926		3900	8 0	11.5
Beef tongue	17 0-270	10-190		740	16s	GO 6
Veal Fresh	۱				· 1	i
Lec lean	900-230	10- 60		أەدا	195	800
Leg medium fat		70-120		7.0	165	GO 6
Loin lean		50-70		61.	13.	741
Loin medium fat	18 0-00 0			824	150	55 6
Loin fat	18 0-19 0			1145	2.0	400
Loin average	199	100		-90	175	57.2
Rib medium fat		30-90		G40	140	714
Rib fat		110-310		1 160	200	38 4
Veal kidney average	169	64		J95	130	77.0
Veal liver average	190	53		575	125	800
	150		1	""		
Lamb Fre h						
Leg	15 0-18 0		1	1 300	290	34 5
Loin	17 0-20 0	25 0-35 0		1.40	340	29 4
Mutton Fresh				i	- 1	
Leg lean	19 0-20 0	12 0-13 0		890	195	513
Leg medium fat	17 0-10 0	1. 0-22 0	í	1 100	240 (	417
Tow everence	197	175		1 085	240	417
Loin medium fat	140-200	26 0-38 0	- 1	1 695	375	267
Lom free fat removed	23 7	185		1 205	270	370
Kidney	165	32		440		103 0
Liver average	23 1	90	50	900	200	500

F d Mat 1	Pe Ce t P t (N 625)	Pe C t	P C t	Fuel Vi P d	F 1 V 1 per 100 G m	Cly ti Gm
Animal Food—Cont					1	-
Dairy Products-Cont						ł
Milk whole	33	40	٠.0	30,	72	1399
Whey	10	03	0.0	125	28	o57 0
Woman's milk*	261	374	634	310	68	147 1
Goat a milk *	346	4 07	464	315	69	144 0
Cream *	25	19.	4.5	93.	200	496
Cream very rich eun						
trifugal †	2.	400	30	1 780	393	25 4
Cream ordinary cen						
trifugal †	30	20 0	39	920	P04	491
Cream ordinary grav	l					1
ity †	υθ— 3 ?	160000	39-40	890	196	J10
Milk ordinary whole !	3.5	4.0	4.5	320	70	1430
Top from one quart of	1		l i			ŀ
whole milk †	l					
Ton 16 oz or upper	1					
one half	34	7.0	4 .	440	98	100 2
Top 11 oz or upper	ł I					
one third	33	100	43	\$60	194	907
Top 8 oz or upper	1		!			
one fourth	<b>5</b> 3	130	42	640	149	676
Top 6 oz or upper	1					
one fifth	32	160	4.0	80	178	562
Whey from whole						
milk *	094	0.90	5.5	110	2,	100 0
Whey from fat free						
milk‡	35	604	37	170	2,	3,05
Matzoon or Zoolak†	990-900	30	37	1,05	390	161 2
Calf's foot jelly	43	i	174	40	90	°63
Lard refined	10	1000	114	4 9 20	9 0	111 1
Lard unrefined	94-30	9 0900		4 010	800	11 2
Oleomargarine	12	930	1	3.00	750	128
Beef juice	49	96		11.		100 0
Vegetable Food	1	) "	1		1	12000
Barley meal and flour	90 130	15-39	.00 710	1 (40	360	
Barley pearled	70-100		70-780		360	2,8
Barley water †	0.09	00.	16	36	8	1950
Buckwheat flour		0 23		1 620	360	27.8
Buckwheat prepara	1.0 100	20		1 020	000	210
tion faring and	ď					
groat avernos	109	04	840	1600	370	271
Corn meal unbolted		4 5.2		1 30	390	263
Corn flour		10-20		1640	360	27 8
Frm L S Dept t Ag	tcoltu e F r	m r Bulleti	> 263			

From II it Th Di fif cy d Childhood w 3 rk 19

Food Mate ials	Pe Cent I rotein (N 1625)	Po Cent Fat	Pe Ce t Carbo hydrates	Fuel Val per P and in C i res	Fuel V 1 o p 100 Grams in Cal i	C 1 ry Por tions in G m
Anımal Food-Cont						1
Meats Cooked-Cont	i	ł	1	ì	ì	1
Loin steak tenderloin	i		i	i .		
broiled	200 0-97 0	12 0-36 (	1	1 300	290	34.
Corn beef canned		12 0-31		1.250	250	35 7
Tongue canned		100-21		1,340	300	333
	320-270	1	1	1,7710	1 000	1000
Inmb Cooked		l				1
Chop« broiled		04 0-3. (	0]	1665	3,0	2, 1
Leg roast	[ 197	127	į.	900	200	00ء }
Mutton Cooked	ŀ	1	1			l
Leg roast	23 0 23 0	29 025 0	o!	1 420	310	373
	200		1	1		1
Pork Cooked		l	J	1	251	356
Ham roast	18 0-26 0	17 021 0 8 037 0		1,210	290	345
Ham smoked boiled			1	1,370	400	2.0
Ham smoked fried	22 2	33 2	1	1815	200	315
Ham luncheon cooked	220	210	ı	1 202	290	310
Poultry Cooked	1	ı	1			1
Capon	27.0	115	1	095	220	4.5
Chicken friensseed	1-0	11	24	€ນນ	100	9 در
Turkey roast	278	184	<b>!</b>	1,290	230	345
Fish Cooked						
Bluefish cooked	2, 9	4.5	1 1	6-0	1.0	C6 6
Spanish mackeret	200			" "		
broiled	237	0.5	1	600	14J	69 0
	1	1	1	1		ĺ
Dairy Products		00 1 1		770	160	69.5
Eggs hens raw FP	11 6—10 0 10 0—15 6		1 1	762	170	.48
Fggs hens boiled	133	11 2		749	165	606
Eggs hen s average Eggs boiled whites	116-148		1	2.0	55	1990
Eggs boiled writes	1. 3-168		, ,	1 700	350	963
Butter	10	8.0	i 1	3 CO.	800	195
Milk buttermilk	30	05	48	16.	36	7780
Cheese American	298	35 9	03	2 000	4.0	27.2
Cheese Cheddar	27.7	368	41	214	470	213
Cheese Cottage	16 0-20 0			J10	11.	870
Cheese Dutch	300-4-0		1	1 435	320	31.2
Cheese full cream	18 0-37 0		12-40	19,0	430	232
Cheese Swiss	26 0-09 0			2 010	440	227
Koumiss	26-30	17-24	9 د1 د	240	ى3	1890
Milk sweetened con	) i		1 1	- 1	i	
densed	60-100	0 4—10 G	44070	1 .90	340	29 4
Milk unsweetened con	í í	- 1	1 1	- 1	- 1	
densed (evaporated						
milk)	80-100	80-100		780	170	588
Milk skimmed	34	03	51	170	39	63 0
					<del></del>	

1				F 1	F, 1	100
	PCI	PCt	P C t		n 100	C l 7
FdM te 1	(N x 6 5)	Ft	hya t	P nd	p 100	l t
			1	c i	Cir	g in
Vegetable Food-Cont						_
Cookies all analy es				l		-
average	7.0	9~	137	1 910	420	238
Cinger snaps	58-73		71 3-80 8	1 695	490	238
Macaroons	31-106		J7 1-71 4	1945	435	230
	51-46		4.8-632		440	928
Doughnuts	° 6- 38		103-169		050	35 7
Pie apple Lie custard	4,	63	261	530	180	
	45 7	97-145			295	9 00
Lie mince		84	217	840		340
Pie squash	44				185	J41
Pudding Indian meal	•	48	97.5	815	160	55 6
Ludding rice custard	28-49	46	31 4 21 9—39 1	8 5	180	5.6
Pudding tapioca	28-4"	23-47	219-3-1	1.0	160	62 s
Hudding tapioca with						
apples	0.3	01	293	500	100	800
Candy			960	1785	39.	253
Honey	0.2 11		173-854	1 590	3.0	PS 6
Molasses	00 51	000"	58867	1 290	250	3.1
Starch arrowroot		l	9 5	1815	400	250
Starch cornatarch			36.0	1 675	370	971
Starch taptoca	02-06	00-30	966-890		360	275
Sugar coffee or brown	1	1	95 0	1760	ng0	256
Sugar granulated		l	1000	1 10	410	014
Surar maple	l	l	740-952	1 49	340	₹ 00
Syrup maple	•	i	45 9-81 9	1 330	492	340
Vegetables	1				}	1
Artichokes	22- 99	01 09	153-183	365	81	1933
A paragus cooked	21	33	23	920	49	204 0
Beans butter green	1		1	Ĭ	1 40	010
F P	94	or	991	740	16.	606
Beans dried	199-061		u7 9—6. 5		3 5	251
Beans lima dried	129-24		616-401		360	27 8
Beans lung fresh		1		• •	000	210
E P	39	63	99	255	56	1/87
Beans string cooked				200	30	1101
F P	0.8	111	19	9.	21	47 0
Beans string fresh		1	1 1 3	00	21	14, 0
F P	1 17- 98	04	196	300	88	151 5
Beets cooked F P	23	01	74	153	41	944 0
Bets fre h F I	09- 30		3 4-163		47	9160
Calbage E I	09-29		34-90		42	938 0
Carrots fresh F I	04-90		6 -13 8		46	0180
Cauliflower	16-00			140	31	373 0
Celery F P	10-14			85	19	J060
Corn green F P	28-3		14 1-00 8	470	105	95 4
Cucumbers F P	0 01			80	18	5560
Lental dried		0 15		1 690	300	275
	1	1	1		510	

	Per C 1	i	Fe C ni	Fuel Value	Fuel Value	100 C lory Por
Food Materials	P t in	Per Cent	4 5	P d	p r 100	Por
	(% x 6 23)		byd te	1 1	c !	l in
	]		l	Cel )		0 m
Vegetable Food-Cont		1	1	i	1	l
Corn meal granular	70120		r 0—50 0		370	2~1
Hominy raw	60-00		77 0-81 0		360	978
Hominy cooked	22	02	179	350	84	1190
Oatmeal raw	13 0-21 0		U 0-700	1 500	410	04.4
Ontmeal bailed	29	05	11.0	245	63	1.30
Oatmeal gruck	09 1 C		3 0-10 0		34	2910
Oatmeal water	0.0 0.0		13-4 -	70	10	661 6
Rice	9-213		75 4-91 9	1 (30	360	278
Rice boiled	16 00		10 0-419	10ء	115	869
Rye flour	49 88		77 0-602	160	760	0,8
Wheat flour	12 2-14 6	21-1-1-	69 77 0	1 675	370	2~1
Wheat flour putent	ſ					
roller process	84-147	03-16	103-800	1 000	3,0	271
Farina	10411"		746-790	1690	3,0	2,1
Shredded wheat	06-114		7-0-797	1700	350	263
Macaroni	70-11 C	00-49	67 2-78 4	1 665	370	27 1
Bread frown as pur		1				i
chased	v0 u9	12 24	436-00"	1 0.0	230	435
Rread corn (Johnny			1			i
cahe)	0 -101		403-043	1,200	250	3,7
Rread rue	64-111		406-106	1150	200	344
Rread gluten	92-111	07 24	44630	1 160	2r0	38 4
Bread graham	r %—109		39 6 31	1 910	2-0	3 1
Roll plain	96-110	04 94	56 ~ 64 7	1 470	320	312
Roll all analy e-			(	!		303
sverage	89	41	J° 7	1,395	310	
Tonsted bread	106-129	06-32	J6 7—67 1	1 420	310	3,3
Bread white home-		ا میا			070	371
made	68-110	04-00	476-090	1,275	270	311
Bread white all analy	ا مما	13		1 215	270	3~1
sed average Bread whole wheat	02 81—117	المواليم ا	ა31 372—აՐ2	1 140	2,0	400
Zwieback	86-117		721-749	19,0	435	23 0
Crackers Boston split			69 9-73 4	1 885	415	24 1
Crackers cream		107-138		1 900	440	228
Crackers graham	74-144		69 7-77 9	1 955	430	239
Crackers oatmeal	104-131	65-137	63 3-69 6	190	435	930
Crackers saltines		127-129		2 005	440	998
Cake chocolate layer	62	81	64 1	16.0	365	27.5
Cake coffee	49-90		24-89	1 625	300	2,8
Cake cup	52 66		C3 2-73 8	1 76.	390	25 6
Cake frosted	JO- 75		J93-710	1 695	375	267
Gingerbread	54-63		623-647	1 670	370	271
Cake sponge	57 73	64-130	573-711	1 795	395	253
Cake all analyses ex						
cept fruit cake aver						
age	63	90	633	16"	370	27 1

Food Materials	Pe C t P t (N 1625)	Pe Ceut F t	P C t C bo- hyd tes	Fu 1 Val Pund Cal	F l V lue per 100 G m C t es	100 C l ry P in Gram
Fruits						
Apples	01 08	01 14	88213	290	64	1561
Apricots E P	11		13 4	270	60	166.8
Banana yellow F P	10~10	06 - 14	163-298	460	100	100.0
Blackberries	09-15		7 -167	2,0	60	1668
	07-11		11 490 6	36.	81	1233
	04 0		93-109	215	47	216 0
Cranberries	13	16	199	4 0	99	11111
Grapes E P	08-11		82 90		4.5	2260
Lemons E P	Vn- 11	01-13	98			
Lemon juice	05 11	01 03		180 240	40	2000
Oranges E P						189 0
Peaches E P	04- 69		93-94	190	42	735 0
Pears E P	06-06	01 08	141-140		Ca	154 0
Plums F P average	10		201	332		1150
Prune F P average			189	370		1920
Raspberries red F P	10		126	255		1785
Strawberries F P	061	04 11			40	950 0
Watermelon E P	03-01	61 03	65 69	140	31	823 0
Fruits Dried		i l				
Apples	10-0	010	49 6-86 9	1 350	300	33 4
Current Zante	10-47		60 0-95 3		830	30 3
Figs	26-		693-831	1 475	395	30.8
Prunes F P	14- 39		68 1-78 6		310	373
Fruits Canned etc						
Raisins E P	23 30	0 . 70	71388	1 005	3 .	991
Apple sauce	02	08	372	730	160	6 5
Marmalade (orange			91.2	•	100	٠,
peel)	80	01	84.5	1 .95	350	3 00
Strawberries stewed	07	**	940	460		1000
Nuts	١ ٠.				1	
			10 5-01 4	3 030	6.0	149
Almon   F I Brazil nut F P	170	GC S	70	3 965	790	13 9
Chestnut fresh F P			369-410	1195	2 0	400
Coconut without milk	36	317	1 5	1 730	340	963
Filbert, F P	1.6	r.3	130	3,290	1 2 -	138
Hickory nuts F P	154	6.4	114	3 345	740	13.5
Penuts I P			1.3-104		762	177
Peanut butter	993	46	171	2 995	622	160
Pecans unpoli hed		1 30	111	2 5.2	6.2	160
F I	06	70.5	153	3 435	760	131
Walnuts California		1	101	01.0	400	131
black E P	919-303	4*78	~ 4-161	3 10.	6%	146
M1 cellaneous		1	1	- 100	1.0	1.0
Chocolate	100 100	177 00	96 5-33 R	0 960	400	
Cocoa	134	971-31	338	o 200	C30	159
Reef soup		03-05		190	26	196
	1-1-6-	10,200	1 00-27	100	20	-10

Food Materials	lerCnt Pin (\x65	l rCe t	P Cent f. rb bydrates	Fuel Val o per Pound in Calo	Puel Vals per 100 G ama C I ries	C lory I or t one in Grams
Vegetables-Cont.						
Lettuce F 1	07 18	01-00	16-49	90	20	2000
Mushrooms	17-60				40	2190
Onions fresh F I	02-44				1 50	200.0
Onion cooked pre-	1	10,2-00	1 **- ***			1
pared	1.2	19	4.9	190	42	12 90
Parsnips	14 19				66	1010
Peas dried	0 4-29 0		30-674		31.5	2
Peas green 1 1	44-80		134-199		10.	20.4
leas green cooked	67	14	146	.40	170	833
lotators raw or fresh	l *'					1
I P	11-30	00-00	1327 4	3%	۹,	1178
Potatoe cooked boiled			101-265		0-	103 1
Potator cooked chip			12 0 6		J00	169
Potatoes cooked.	100-10	00 3-71	-000	.,		
mashed and creamed	00-36	10-4	13 9-22 4	500	110	909
Potatoes spect raw or	20-00			500		1
fresh L P	04-37	00 - 14	17 1-49 1	ر70	120	600
Potators cooked and	VI- 01	0.2- 17		٠,١٠		1 ***
prepared sweet	30	21	421	925	200	300
Sweet cas ava	11	02	30.2	610	13.	741
Ca sava stareli *	0.	01	85.5	1 (3)	360	27.8
Cas ava bread	91	01	700	100	365	27 4
Cassasa cakes or	7,		100	100		1
wafers *	11	02	8,2	16.0	870	270
Taro *	18	02	23.2	41	10.	8.3
Yams *	18	02	23.2	10	105	9.3
Lautia tubers	22	02	261	535	190	833
Radishes F P	0 30	00-03		135	30	3340
Spinach fresh	18-24	02-0	31-34	110	12	1170
Spinsch cooked	21	4.1	26	260	7ر	1754
Squash E P	06 31	01-14	3 -16 -	210	41	2160
Tomatoes fresh	03-13	02-14	22-6-	10-	23	135 0
Turnips	07 39	01-04	28-239	18-	41	244 0
•						
Vegetables Canned	09-24	00 09	22-41	85	19	,960
Asparagus Beans baked	-1-81		13 1-23 2	600	130	740
Beans string	06-40	00-0	20-135	9.		177 0
Beans lima	32 6		10 -17 9	360		1967
Corn green	20-37		98-9 8	4,5		100 0
Peas green	16-61		49-174	2 ,		178 5
Succotash	29-44		14 9-22 4	455		100 0
Tomatoes	03 1"		14-81	105		435 O
Catsup tomato	11-20	01-04		26.		1723
Ohves green E P	11	270	116	1 400	310	32 3
Pickles cucumber	04 0"	01 05	13-54	70	15	b66 6

From Bulletin No -9 Bept of Ag iculture

PERCENTAGE COMPOSITION OF TRLE AND SO CALLED GLUTEN FLOUR
From Wiley Fools and Their Adulteration Philadelphia 1911

N m	P C t	P C t	C b hyd te
Gum glutin (Hoyt s)	31 90	1 55	541.
Educator standard gluten flour	26 40	167	J9 38
Gluten flour 40 per cent	40 25	1 18	47 49
•	41 10	110	47 90
Self raising gluten flour 40 per cent	38 70	1 30	50 10
Pure gluten flour	78 80	090	12 60
20 per cent gluten flour	21 00	070	68 20
Pure gluten flour gluto se	35 00	0 60	00 س
Gluten food	95 40	0 -6	3 69
Protosae	36 f 0	0.86	51 03
Washed gluten flour	6940	0 91	P9 51
Glutosac	3106	1 57	52 13
Diabetic biscuit flour	75 °>	8 96	5 89
Plasmon meal	*8 G	2 72	0
Aleuronat	86 10	1ن 0	4 00
	73 65	0 of	14 55
Roborat	82 20	3 67	3 00
Wheat protein	8410	140	4 80
Energin from rice	8370	4 54	0 67
Vegetable gluten	e13"	1 .5	28 73
Casoid flour	85 ⊌€	0 50	0
Sanitas nut meal	29 00	51 66	1913
Soy been meal	39 87	19 06	25 09
Almond meal	5000	15 <del>6</del> 3	15 90
Gluter flour	11 37	0 90	74 38
Gluten flour	1 50	2 60	70 80
Diabetic flour	12 00	040	76 45
Jirch diabetic flour	14 0	2 21	71 95
Special diabetic flour	140	2 96	67 47
Gluten flour	1339	10	79 11
Cluten flour	1640	31,	1060

the muscle filers. While heat co guilte the albumins of meat and it is thought renders them slightly le's digestible this effect is probably more than offset by the above-mentioned advantages, unit is the meat be cooked too lone.

Vegetables consist for the most part of turch which is incloved within cellulose walls. Cellulo e is practically undigested by man, and much of the starch of risk regetables e capes from the body in the feres. Moreover, raw starch itself is difficult of digestion. During the process of cook, ing the starch grains swell, burst the cell walls and become softer. In addition starch is converted partly to destrue, thus occurs both in moist and dry heat.

					_	
Food Materials	P Ce t ) rol i (\ x 8 5)	PerC t	Per Cant Carb bydrates	Fuel Val a Per Po d in Calori	Fu 1 Val e per 100 G ams 1 Calories	Pe t ns In
Miscellaneous-Cont.					<u> </u>	
Bean soup	32	14	94	295	6.	1540
Chicken soup	10 .	08	24	270	61	1610
Clam chowder	07-29	05-11	25-110	19.	43	360
Meat stew	37- 56	20-64	43-79	370	82	1030
Soups Canned					ļ	
Asparagus cream of	2.	3.2	5.5	295	63	1590
Bouillon	17-26	00 02	01-03	۰0	11	109 O
Celery cream of	21	28	0 ب	2.0	50	1890
Chicken gumbo	30-46			190	43	960 د
Chicken soup	32-39	00-00	12-17	100	27	40
Mock turtle	4 59			18 ₀	41	1410
Oxtail	39-41	05-21	42-43	210	46	7190
Pen soup	15- u8			235		1925
Tomato soup	17-19	09-12	v3 60	185	41	o110

### THE EFFECTS OF COOKING UPON FOOD?

The practice of cooking food is universal. All existing races follow the custom, at least as regards part of their food, and archeological researches indicate that the art of cooking extended fur into prehistoric times. Cooking plays an important part in the preparation of food for human consumption. Substances which in their natural state are insigned and nearly, or quite, indigestable become valuable foods when subjected to the processes of cooking.

to the processes of cooking

The objects sought in the cooking of meats and regetables are essentially smaller. They are as follows

1 To develop flavor and improve the appearance of the food

Foods which are attractive in appearance, of pleasant aroma, and savory tasts strainlate the secretion of the 'appetite juice,' and thus indirectly become more directly become more directly become more directly become more directly because

2 To increase its digestibility

Cooking produces both physical and chemical changes in the food. It is more important in the case of vegetables than in the case of meats. Both our rendered more directable.

In the process of cooking the connective tissuo of meit is softened and in part converted to gelatin. In consequence, mastication is easier and more complete, thus insuring freer access of the digestive juices to

^{&#}x27;In the preparation of this section the author has derived much assistance from U S Dept of Agriculture Bulls Nos 43 67 and 102 and Farmers Bulls Nos 34 and 389

PERCENTACE COMPOSITION OF THE AND SO CALLED GLUTEN FLOUR
From Wiley Foods and Their Adulteration Philadelphia 1911

N m	P Cent	P C 1	Per C t
Gum glutin (Hoyt s)	31.80	1 55	54 15
Educator standard gluten flour	96 40	1 67	59 39
Gluten flour 40 per cent	40.2	1 18	47 49
=	41 10	110	47 90
Self raising gluten flour 40 per cent	38 70	1 .00	010
Pure gluten flour	78 80	0 90	10 60
20 per cent gluten flour	21 00	0.70	69 20
Pure gluten flour glutosac	3a 20	0.60	5 v 00
Gluten food	8a 40	0.6	3 69
Protosac	36 60	0.86	51 03
Washed gluten flour	62 40	0 91	29 51
Glutosac	34 OC	1.7	52 13
Diabetic bi cuit flour	75 2.	8.96	5 89
Pla mon meal	78 F.	279	0
Aleuronat	86 10	1ر 0	4 00
	73 65	0 24	14 5
Roborat	89 20	3 67	3 00
Wheat protein	84 10	140	4 60
Inergin from rice	83 40	4 54	0 67
Vegetable gluten	61 37	1 55	29.23
Casoid flour	95.5°	0.50	0
Sanitas nut meal	29 00	51 66	10 13
Soy bean meal	39.87	19 06	25 09
Almond meal	5012	15 63	1. 90
Gluten flour	11 37	0 90	74 35
Gluten flour	10	2 60	70.80
Diabetic flour	19 00	0.40	76 45
Jirch disbetic flour	14 30	2 21	71 95
Special dist tie flour	142)	2 96	P7 47
Cluten flour	13 30	10	2 11
Cluten flour	16 40	3 15	70 60

the muscle fibers. While heat congulates the albumius of ment, and, it is thought renders them slightly is a digestible, thus effect is probably more than offset by the above-mentioned advantages, unless the ment be cooked too lone.

Vegetables consist for the most part of tarch which is inclosed within collibor wills. Cillubor is practically undure ted by man and much of the starch of raw vegetables e capes from the Lish in the feece. Moreover, raw starch itself is difficult of dig tion. During the proce of cooking the tarch grains swell burst the cell valils and become softer. In abilition starch is converted partly to dectrin. thus occurs both in min t and dry heat.

Lycept for the development of flavor, fats are probably affected but

3 To de troy parasites and bacteria

When meet is taken only from healths animals and is properly in spected, there is little danger from parasites or betteria. But the e precuntions are not always followed especially in the case of meats which are old to the poor, therefore, meats of doubtful origin should always be thoroughly cooked.

Vegetable foods, likewise, may earry infection. The typhoid bacillus, for example, may enter the look upon green vegetables which have been washed or grown in politied water.

Cooking Meats - The various methods of cooking meats may be

grouped under two headings

1 Methods which are intended to prevent the loss of the juices of the ment, such as rousting and brothing. By these methods the ment is heated rapidly, the surface allumin congulated, and the juices of the ment returned.

2 Methods which permit the loss of the junces, such as boiling and stewing. With the concludes the most is heated slowly, and the junces

escape to a greater or lesser extent

Losses in Looking Meal—Meat loses in weight whitever the method given weight of cooked meat holds a higher percentage of nutriment than the sime weight of cooked meat holds a higher percentage of nutriment than the sime weight of raw meat. According to Grindley, the loss in weight amounts to one-fifth to one-third, whether the meat be looked or roasted. The loss in the solids of the meat is greatest when it is louled or stewed, and the longer it is cooked the greater the loss. The loss may reach from 3 to 20 per cent.

While meat which is boiled gives up most of its flavor to the water and becomes inspired it to esserts little of its instrument. It is thought of beef ter which give rie to the fallacy that it centuried the nutritions

clements of the most in quantity

Cooking Vegetables and Losses Incurred —Losses occur in the cool ing of vegetables, which are comparable to, but perhaps not so important as those which occur in the cooking of neats by methods which do not retain the junces. The losses in the cooking of vegetables depend largely upon the method employed, and concern chiefly the sugars and salts which are soluble in water, though introgen also is lost. The losses to which potatoes, carrots, and cabbrings, selected as types, are shiplet have bestudied by Snyder. His experiments showed the following results

1 That in order to obtain the highest food value, potatoes should

not be peeled before cooking

2 When peeled, the least loss occurs if the potatoes are put directly into boiling water, though the loss is still considerable

3 When pecled and soaked in cold water before cooking, the loss may reach one-fourth of the protein matter

Similar losses may occur in the cooking of carrots and cabbage

Breadmaking —Snyder and Voorhees inve tigated the lose of flour in breadmaking. They affect both the introgen and carbohydrate. The loss in introgen may reach 145 per cent. The circhohydrate loss is caused by the fermentation which the bread undergoes in rising? (yeast cells) The authors state that the 15 ses in breadmaking need not exceed 2 per cent of the flour used and may be reduced to 11 bit cent.

Gereal Breakfast Foods—The importance of cercul bracking foods has been shown especially by the investigations of Woods and Sinvder Brees authors found that cereils comprise 22 per cent of the total food of a large number of families in this country furnishing 31 per cent of the protein 7 per cent of the fat, and so per cent of the total carbohydrates. They have separated the large number of cereal breakfast foods which are on the market into three groups.

1 Those prepared simply by grinding the grain

2 Those which have been steamed or otherwise partially cooked, and then ground or rolled

3 Those which have been acted upon by malt which induces chemical changes in the starch

Cooking Cereals—The proper cooking of carcals as of more importioned than the relative proportions of nutriment they contain. While definite statements cannot be mide regurding, the length of time which different ecreals should be builded all of their require prolonged cooking. They are much more likely to be undertooked than overeoked With undercooked foods starch grains may appear in the feest due to the coverings of the graindes which are importanciable to the digestive juices. In general the more abundant and the tougher the fiber the longer should the process of cooking be continued. For example, whole grains require, more cooking than crushed grains. Rue contains but little fiber and may be throughly cooked in a relatively short time.

According to Woods and Snyder it is difficult to know in the case of partially cooked breakfast foods how much of the necessary cookin, has been done in the factor. They point out that overcooking is barmless and suggest that further cookin, in the boint is usually desirable.

Framunations of malted breikfist cereals carried out at the lows Farenaum Station showed that the largest amount of soluble carbohadrate press it was 13 per cent of the total earl bladvices the lowest, 0.3, per cent. The average was around per cent. It the Michigan Station it was found that the largest proportion of the soluble carbohydrates in the e-preparations come to of destruit. Woods and Savder state that the claims made for some brands that the earbohydrate are completely or largely produgsted are quite unwarranted.

#### DIOESTIBILITY OF FOODS 8

Oeneral Considerations —The term "dujectibility" may be under stood to mean either the case and rapidity with which a food is digested, or the completene s of its digistion. This distinction is not always made, however, and confusion has often arisen in the interpretation of the results obtained by different observers. I have set, when the opinions of physicians and physiologists are not in agreement, the fact is often over looked that the conditions under which the observations are made are different. Physicians deal with those who are till, physiologists with those who are till, physiologists with those who are util. The term "directibility" is probably understood by most physicians to mean en e of digestion, by most physiologists completiones of digestion. If these different points of view are borne in mind, discordant opinions may frequently be reconciled.

I oods leave the stomach in the order in which they are digested and liquefied. The length of time they remain in the stomach has been taken by some authors as the measure of their digestibility. While the length of its sojourn in the stomach may not affect the thoroughness with which a food is ultimately digested, it may have an important influence upon sub-equent feedings especially if these be given at short interrals. Delay in gastric digestion often produces in healthy per one unusual or uncomfortable sensations referable to the stomach. In persona who are all, delay of gastric digestion may not only interfere with the frequency of the feedings, but may cause loss of appetite, naises, and even the rejection of food.

The mitritive values of foods cannot always be measured by the amounts of the different foodstuffs they contain. They depend rather upon the extent to which these foodstuffs may be digested and absorbed While it is generally believed that the greater part of most foods is digested and ab orbed by healthy men, our knowledge of the extent which they are utilized by persons who are ill is far from complete

A number of factors affect the digestion and utilization of foods.

The favorable influence of appetite upon digestion has been known so long that it is best expressed in the form of the adage, "Hinger is the best sauce". It was only about twenty years ago, however, that Paylor established the popular behef upon a scientific basis through his diversory that the desire for food induces a reflex stimulation of gastric junce. Paylor calls this secretion the "appetite" or "igniting junce". Its function is to initiate the digestive process, which then proceeds more or less automatically through the stimulating action of the products of

In the preparation of this section the author has derived much information from U S Dept of Agriculture Bull No 85 and Farmers Bulls Nos. 85 1 1 198 18?

digestion upon the gastine glands. Food eaten without appetite may be in the stomach unchanged for hours. Physicians have made use of this knowledge for many years, and have striven to arouse an appetite in patients when it was lacking. Another and related, sdage, "Laugh and grow fat," finds application here. Meals eaten amid cheerful surroundings and in pleasant company are trken with greater zest and enjoyment, and are more evolv discessed.

The case and completeness of digestion also depend in general upon the amount of food which is eaten at a time—the greater the quantity the less rapidly and probably less thoroughly, is it digested. Occreating is a common cause of digestive disorders. The custom of taking three meals a day is based upon the general experience of manking that the amount of food required can be headled with less tax upon the digestive organs when distributed in this manner.

Careful regulation of the quantity of food allowed at one time is of even more importance when per ons art ill or have weak digestions. The common precision of gruing small quantities of food at frequent intervals to persons with enfectbed powers of digestion is supported by the experiments of Paulay who found that if food was given to a dog in small quantities at internals the gastree junes was stronger than if the whole ration had been given at once. Moreover the appetite of an invalid is often impured by even the sight of large portions' of food. Experiments upon he lithy men have repeatedly shown that a well

Experiments upon healths men have repeatedly shown that a well bulanced dietary is digested more thoroughly than a single food. The significance of such obervations with respect to the arrangement of

dictaries for invalids, is apparent

The scretton of gestre jure is intimately related to the quantity of water in the body (Pavlos) Water is drawn from the blood by the water in the body (Pavlos) Water is drawn from the blood by the cells of the gastre glands as the elaborate the scretton. If the supply of water is not sufficient the dieg time jusces are deficient in quantity and digestion is impaired. Therefore water should be supplied to the body be encental or otherwise as an aid to digestion in discusse attended by its loss in large quantities, such as ever sive comiting, profuse diarrined, and hemorrhage. I very food determines a certisu amount of digestive work, and hiera is given determ is long-continued, definite and fixed types of gland activity are set up which can be altered but slowly and with difficulty. In consequence digestive di turbuners are often in tituled if a change he made uideally from no elictrix rigime to another especially from a spirits to a rich diet. (Pavlos). It should be added that patients cannot all be fiel able, even when suffiring from the same disease. In judices and idosvinersies to foods are not removed by the standard water him and should be permitted in disease to the extent which is compatible with the princip is well being

Digestibility of Meats—Numerous observations concerning the digestibility of ments have been made upon health men. Valuable data have also been obtained by Parlos and his convertes from their experiments upon dogs. But we poless very little information respecting the digestibility of ments in various diseases. The conclusions drawn from experiments upon health men refer particularly to the thoroughness of digestion. They should not be applied without caution to persons who are all, and who, on that account, may digest ment slowly and with difficulty.

Probably the most important conditions affecting both the rate and completeness of direction of intit are the amount of connective tissue and fat it contains, and the nuthed and duration of the cooking

The "appetite" juice place a less important role in the digestion of most than in the digestion of eggs and bread. This is due to the presence of extractives in ment, which are direct exectants of the gastro glands According to Parlou, the exection of "ment juice" is the most rapid of all. Raw must introduced unnotized into the stomedi of a dog exeites secretion within from 15 to 10 minutes. But if ment le freed from extractives by prolonged boiling and the water be forced from it by compression it has no stimulating effect unou the greating clands.

The influence of the connective it sue upon the digestion of must is mainly incelianteed, though the instruction of tough, fibrous meat is not attended with pleasure. The pre-cite of muck connective is use preents free access of the digestive junes to the invoice fiber, and affects both the rapidity and completioness of digestion. The practice of pounding ment across the cut ends has for its object the epiration of the musele fibers from the connective tissue. Inkinise the prolonged cooling of ment converts the connective tissue into gratum, and frees the musele fibers, though they are probably rendered slightly less digestible by the process.

Influence of lat Content Digestron of Vieat — Ments vary in the amount of fat they contain — Direct meat may not have more than 3 per cent of fat, while pork may contain as much as 50 per cent. The presence of fat inhibits the secretion of gastric juice, and prolongs the stay of both protein and carbohydrate in the stometh. Therefore, the rapidity of the digestion of meat bears a direct relation to the amount of fat it contains — Fat ments such as pork, are well known to be difficult of digestion.

While but little attention has been devoted to the percentages of the different ments which are absorbed, it is probable that ment of all kinds, whether raw or cooked, is very completely absorbed by healthy menually all of the protein and about 95 per cent of the fat

Our knowledge of the digestibility of ment in disease is confined largely to the results of climical observation. While carefully made ob-

servations of this kind have a definite value, it is desirable that they should be confirmed by experiment Yet, one of the conspicuous features of Pav lov's work is the frequency with which he has confirmed both popular and clinical beliefs respecting direction

In giving ment to invalids every precaution should be taken which will make for ripidity of digestion. It should be served attractively and in not too large portions in order to promote the secretion of the "appetite" juice. If given raw it should be finely setaped, as this separates the fibers from the connective tissue. It is ment should not forced upon a patient, since it is not certain that raw ment is more quickly digested than slightly cooked ment. If cooked too long the music fibers become hard, tastle is to many persons, and difficult to digest. Furthermore ments which contain relatively little fut should be selected for unvalids.

Poultry is popularly supposed to be more easily digested than red mats. As no experiments contrader this blief, it may provisionally be accepted. If true it is probably due to the tenderness of the fiber and the relatively small proportion of fat. The fatter kinds of poultry art less easily digested than the learn. The popular belief that the light meet is more digestable than the dark may be due to the higher proportion of fat in the dark meet but the difference is slight.

Attention should be directed here to the fact that the extractive-content is essentially the same in white and red ments. In diserves where it is desirable to reduce the purin bedies to a minimum there is no advantage in prohibiting red ments if the patient is allowed to ext poultry at will. It is probably true so far as the sick are concerned that the milk difference between white and red means concerns eyes of direction.

Digestibility of Fish —The relative digestibility of different fish appears to be dependent upon the amount of fat they contain. Langworthy has grouped the commoner fish from this standpoint, into three classes

1 Fish containing over 5 per cent of fat salmon, shad, herring Spanish mackerel, and butterfish

2 Fish containing between 2 per cent and 5 per cent of fat white-fish, mackerel mullet, halibut, and porgy

3 Fish containing less than 2 per cent of fat smelt Idack hass, blue-fish, white perch, weakfish brook trout, hake flounder, yellow perch, pike pickerel, sea hass, cod, haddock.

Digestibility of Eggs —Most of the experiments upon the directibility of eggs have been made upon healthy men and lower animals. All of them indicate that eggs are cards and thoroughly dige ted. Rubner found that with a diet consisting of hard boiled eggs alone the introcen was absorbed to about the same extent as that of meat while, the fat was absorbed better than the fat of meat. Anfrecht and Simon studied the absorption of lightly boiled and raw eggs, compared with meat, as part

of a mixed diet, and found that the absorption of both the mitrogen and fat was greater in the egg—than in the mixet—priod. They concluded that lightly builed and riv eggs have a higher food value as part of a mixed diet than a corresponding amount of meat.

The method of cookin, e.gs appears to affect the rate rather than the comprehenses of their digistion. While this has no appreciable effect in health, it may cause disorders of digistion in discise. Indiged by the length of time they remain in the stomach, eggs are digested in the following order (the most civil) digested are given first). Infully cooked e.gs, raw eggs, buttered e.gs, hard boiled e.gs, onaclete. Judged by the completeness of absorption, Aufrecht and Sunon have aboun that lightly boiled e.gs have a somewhat lower mutritive value than raw eggs. Jorns some behaves that if hard boiled e.gs are thoroughly masticated they are digisted as easily as highly cooked e.gs. Yers few experiments have been made upon the relative digistability of the white and the oxld of the e.g.. Stern found that rive or half raw volk is realily digested, and Row and Macleod have found that there is very little difference in the digistability of rive or cooked whites of eggs.

While it is probable that the facts regarding the digestibility of eggs by healthy men apply equally to those who are ill, positive statements to this effect cannot be made. Probably the most important factor influ enemy the digistibility of eggs in disease is whether they are taken with relish. White of egg exten without appetite will lie in the stomach un changed for a considerable time (Paylov). This is due to the fact that the egg contains ne substances like the extractives of meat which are capable of exerting the flow of gastric pince. Once the flow is started, the products of direction stimulate further secretion. If water be taken with egg albumin it initiates the scercion (Paylor) is obtained if the egg is preceded by, or given with, ment broth. The difference in digestibility between lightly cooked and raw eggs is so slight that it is not necessary to compel patients to take them raw. When a patient's digistive powers are much enfectled, eggs should not be but tered, but there is no objection to the addition of salt and pepper Fraser found in experiments upon the artificial digestion of eggs that tea, coffee,

Idiosyncray to Eggs —Persons are seen occasionally who have an life The symptoms develop after eating egg even in small quantities and irrespective of whether it is taken alone or combined with other foods, as in custards The symptoms are often severe, collapse may occur liftenria is common

and cocon retarded digestion of the protein, though the effect of coffee

was less marked than that of the others

The Digestibility of Milk —The following account of the digestibility of milk is taken principally from Pavlov There are three properties of

milk which secure it an exceptional position. Milk, when compared with the smallest quantity of pancretic fluid Consequently, the secretory activity necessary for its assimilation is much less than for any other food When milk is introduced mechanically into the stomach of an animal, it can es a secretion both from the stomach glunds and all o from the pan ereas, consequently it appears to be an independent clumical excitant of the digestive canal and in this action there is no essential difference whether the milk be introduced directly into the stomach or be given the animal to lap Milk excites not only a really effective but also a very economic secretion and the appetite is unable to stimulate this secretion into a more active or abundant flow. The price which the organism pays in digestive work for the nitrogen of milk is much less than for other foods

Idiosyncrasy to Milk -In rare instances persons exhibit an idiosyn crasy against milk Halberstadt considers this to be evidence of a con genital constitutional anomaly. The idioviners may be again t the al bumin fat, or wher In some cases the deleterious effects of milk are thought to be due to a change it causes in the flora of the intestine Defi into poisoning occurs in the e cases often accompanied by inflammatory changes in the alimentary tract and must be differentiated from the diges tive disturbances which many physicians claim are always caused by milk Tugendreich has described a similar poisoning under the title of Buttermilk Lever

Digestibility of the Carbohydrates —The digestibility of the carbohydrates depends in general upon the relative proportions of starch (or ugary and cellulose The greater the amount of cellulose and the thicker the cell walls the less diggestable is the food. The preparation of certain foods, such as the milling of grain has for its object the removal of the treater portion of the cellulose Sugars may be regarded as partially directed earbollydrates. Except when taken in quantities and in mix three which interfere with the normal processes they are easily dige ted

and completely absorbed Ctrlohydrate kave the stomach quickly
Bread and cereals may be taken as types of the carbolydrate foods

Digestibility of Bread —Bread is generally con idered to be an easily dige ted food, but the appetite juice is nece are for its perfect diges tion Bread eaten without appetite may be in the stomach for a long time without change. Bread is digested chiefly by the patternate secretion. The lactic acid which is formed in the stomach stimulates the papereas and thus aids the direction

The majority of the experiments on the dige tibility of bread relate to the completeness of its digestion by healths men. Meer and Voit, ex perimenting with different kinds of wheat and rie bread found that the digestibility of bread depended chiefly upon its lightness. Studies car

ried out at the Minnesota I variance. Station upon the digestibility of broads undo from priham whole wheat and standard patent flours don outstrated that broad made from standard patent flour was most completely directed, whole wheat broad next, and graham least. The digestibility of crackers, macarom, and various sweet cakes made from white flour was found at the same Station to be essentially the same as that of hered.

There is a popular behicf that cold bread is more easily digested than bot bread. This is probably true but it is due to the physical condition of the bread and not to the lie it. Hot bread is more, and if not sograbe four learn, either is compressed unto tough man escharing mastication, and thereby rendered less easily disjetible. If properly made, cold or still bread contribute is most experiment and is not epen to the same objection in that it does not form the constitution of the structure.

As fir as is known the above facts are applicable in disease. Du Dois found that bread and crickers are easily and completely digested by

typhoid fever patient

When bried and sumfir foods are eiten by per ons who have little or no appetite the schoold be combined with substances which have a head stimulating action upon the patter glands. Water is sufficient for the purpose but must broth is often to by preferred.

D gestibility of Cereal Breakfast I oods—The digestibility of cereal breakfast foods has been more to itself at the Connecticut, Maine, and Maine of a Nyeriment Station. The results showed that in healthy men the cereal breakfast foods in general are somewhat he a digestible thru white break. It was found at the Mich, in Programment Station that the great part of the soluble cribolish drifts in the so-called predigested breakfast.

foods consists of dextrin

Digestibility of Fat—I it illustrates especially well the distinction which must be made between eves and completeness of digestion. All healthy persons consume daily larger or smaller quantities of fit in the form of butter excime or the native fits continued in other foods. But an excess of fut over the usual quantity or a cleange in its form is distantion, and may produce man experience and future of a cleange in its form is distantion), and may produce man expected excepts it is tolerated by the stomach, only a small portion of the fut ingested escapes absorption in health.

The is not directed in the stomuch but may have an important in finence on gastric direction. Fat everts an inhibitory action upon both the psychic or "appetite" and local gratine juices, and delvis the private gives of the clyme into the direction of protein, and explains the well-known fact that fatty protein foods are difficult to digest, whether the fat be native to the food or be added to it in the process of cooking. On the

other hand, the addition of fat to starchy foods, for example, bread and butter, is cu tomary, and according to Pavlov, rational I read requires little gastric mice for its direction the fat restrains the activity of the gistric glands, while it the same time it promotes the secretion of pin ereatic pince, which is needed for the direction of the starch, the partially diested protein, and the fat it elf Though an excess of fat in a mixed meal may cause disturbinees of discistion fat alone even when taken in relatively lar a quantities as not difficult to direct

Large amounts of fat may can regurgitation of the duodenal con tents into the stomach. This fact has been of erred both experimentally

and clinically (Pas ler)

Ordinarily, fat is well absorbe I in he dith. Its absorption appears to by related in a measure to its malting point. Butter, with a melting point of 37° C is more completely all orded than mutton fat with a melting point of J2° C. When the find intuits 50 to 100 grains of fit only to be per cent as lo t permally make feces

The absorption of fit varies andly however in diense to Umlar, 4) per cent of meested fit may be lost in the fees when the bile duct is occluded. Thus in ab tructive conduce fat absorption may be interfered with In discuss of the punctures the loss may reach 7 per cent. On the other hand, the ab orption of fit in typhoid fever is often remarkable 5 me of my pittent studied by Du Bois when tiking 2.0 grams of fat a day in the form of roun and butter lost an average of 72 per cent in the feets in the terp-curved period and in convolescence while taking similar amounts they lost 45 per cent

Length of Time Food Remains in Stomach - The length of time which a food remains in the stomach has often been accepted as the meas are of its digestibility but is prohibly only an indication of the eac of its direction

The length of time which certain foods remain in the storagely is hown in the following table of experiments by I enzoldt

	ONE TO THO HOURS
Crams	Aun I of Foo
100-2 0	Water
9.0	Charg'd water
900	
900	Caffee Wathout
900	Core Without
φ( <b>)</b> ()	Beer
100	Inht wine
100- 00	I ded milk
900	W it lr th
(H)	I plone in water
100	क्षा ग्रेश स्टूल

### TWO TO THEFT HOLES

Grams	Aind of bood
200	Coffee with cream
200	Cocon with milk
200	Malaga wine
300-300	Water
300-200	Beer
300-200	Borled milk
100	Raw scrambled hard boiled
	egg and omelette
20	Calf's Irain boiled
19	Raw oysters
200	Botled carn
200	Boiled pike
200	Borled haddrek
200	Dried codfish
1.0	Boiled cauliflower
150	Cauliflower sala l
1,0	Boiled a paragus
1.0	I otato
1 0	I ofato soup
1.0	Cherry preserves
1 0	Ran cherries
~0	White brend fresh or old
	dry or with ten
70	Cracknel
J0	Albert biscuits
Т	mere to both Hotes
230	Boiled young fowl
2.00	Roast partridge
220-200	Boiled pigeon
195	Roast partridge
250	Beef raw or cooked

Botled calf's foot 2,0 Ham raw or cooked 160 Roast seal warm or cold 100 100 Broiled beefsteak cold or warm Seraped raw beefsteak 100 Tenderloin 100 200 Rheinsalmon boiled 72 Caviar Rye bread 150 Graham bread 1.0 Albert be cuit 100-1-0 Boiled rice 1.0 1.0 Boiled cabbage Roiled carrot 150 Smusch

Raw radi h

Apple

150

150

150

	Four to Five Hours
(rams	Kind of Food
210	Roast pigeon
2.0	Broiled filet of beef
20	Broiled steak
9.0	Smoked tongue
100	Smoke 1 meat
2.0	Roast hare
940	Poast partridge
9.0	Roast Long
2 0	Roast duck
900	Salt herring
1 0	l'entil sup

100

CORFRIGIENTS OF DICESTIBILITY (ABSORBABILITY) IN DIFFERENT CROUPS OF FUOD MATERIALS.*

I a some

x 4 1 F 4	P Cent	PFCI	P C at
Meats and fish	97.0	9, 0	
k pgs	97.0	200	1
Dairy products	9 0	9 0	980
Animal food (of mixed diet)	940	9.0	990
Cereals	85.0	900	99.0
Legumes (dried)	4.0	8410	970
Sulars		1	930
Starches	(	1	940
\ rgetables	43.0	90.0	9.0
Fruits	8 0	900	900
Vegetable fo 14 (of mixed di t)	84.0	900	370
Tetal food (of mixed diet)	9,0	9 0	9~0

Fr Un Dept f Ages it tre Fn Butt \

### EFFECTS OF STARVATION

It will be necessary to distinguil between the effects of complete and of partial disprivation of food. Starvation is complete when a person receives no food and the energy necessary for the continuance of life is derived from his own 1 sls. Partial starvation occurs when a person of receives oils, a portion of the food he requires. Under such circumstances the tissues of the body are drawn upon for only part of the necessary areas. In actual practice however the plus ucan mut take into consideration the possil de turbances of metalon in produced his the discussion which the pittent is suffering and which also may be a cause of the starvation.

Effects of Complete Starvation —Complete abstinence from food for short periods is not—or at least is not likely to be—harmful in the case of a lult—Nature provides for such emergencies by accumulating reserves

of alveagen and fat Young children, on the other hand do not bear starvition well even for hort periods. The reserve supply of glycosen is relatively small, and is soon exhausted. After its exhau tion, the holy derives all of its energy from protein and fat. Lat, which is of leser importance is sterified in fivor of protein. The heavy demand made upon the fat results in its incomplete combustion and the occurrence of acidosis with acctone bodies in the blood and urine

The expenditure of energy by the body remains normal for the fir t day or two of complete turnition. Lubuer reckons it at from 30 to 32 calories per kilo_ram of body weight. When the subject is at absolute rest lawever the heat production may fall to 22 to 26 cilores per kilogrum (Atwater Liger tedt, Magnus Levy). The e figures represent the minimal metaboli in compatible with life, and council be applied in practice, because nationts are rurely or never at complete re t, unless they are asleen or in coma

Loss of weight is characteri tie of starvation. It is due to the con sumption of the body to succeed to the channation of water and salts As the weight diminishes the expenditure of energy falls the fill record m_ to Rubner corre ponding to the los in weight. The body tempera ture remains practically con tant. The urme is dimini hed in amount The los of mitrogen is large for the fir t day or so, after which it remains furly con taut (10 to 1 gruns) for a week or ten divs. Material divergence from the chigares indicates the influence of di cise. However, in long fists factor other than the simple sparing of the direct effect of food come into play

Penedict has shown that recovery from starvation is rapid in health and may be followed by an actual gain in weight. I isting for short periods apprars to stimulate the body to mercuse its store of fit. This

is regarded by Penedict to be a protective incelanism

Effects of Partial Starvation - Partial starvation may occur through force of circum times such as poverty or as the result of discret In the latter case it is not always easy to distinguish between the influence of insufficient food and that of the disease From the medical standpoint partial starvation probably occurs with greatest frequency in prolonged febrile and in malignant diseases

The body is expuble of regulating its expenditure of energy to some extent. When the food supply is insufficient the production of energy fills correspondingly But von Noorden believes that the minimal amount of energy required by per ons who are bedridden, or who remain indoors and do but little work unounts to from 30 to 22 colories per kilogram Their diets should be arranged upon this basis. Persons who are under fed conomize their protein at the expense of the le's important fat. The longer the deprivation of food continues the smaller the relative amount of protein consumed

It should be added that per one who are undernourished are less able to resist invasion by bacteria and to combat infection

#### EFFECTS OF OVERFEEDING

A person is overfiel when he takes and absorbs more food than is required for his energy exchange. If an excess of food is not disc ted and all orbed, it is likely to cluse illimentary disturbances

The effects of overfieding may be either physiological or pathological that is, the ceneral condition of the person may be improved or virious disturbances of function may be brought about. We are concerned here chiefly with the physiological effects of overfeeding

I person who is overfed a uns in weight largely through the deposi tion of fit, though there may be a consider retention of nitrogen. Fat is a relatively inactive to sue from the metabolic tandpoint. The neumin lation of fit adds to the re erres but does not mere; the power of the body Improvement in tone if B t growth of mu cle is nece sary to lung the body into a state of vigor us health. This depends to a great extent upon proper exercit and should be borne in mind when one is emplying the overfieding cure

The objects to be sought in overfeeding may be either the accumula tion of fat, or improvement in the condition of the mu cles, or both. In arranging the diet the effect of the different foodstuffs must be taken into consideration. Lat is the last to all for simple fattening purposes becau e foreign futs are deposited in the body without change and with the expenditure of very little energy Curbohydrate ranks next to fat in value. It has been a timated that one furth of the potential energy of carbohydrate as hat he fore at as deposited as fat I ratem as he ast valuable I wante of the morea a it can es in metal them and because it cannot add miterally to the store of fat. Therefore, an increase in pretein alone is treational in overfeeding ours. Van V rien advis a perificilly again t the employment of proper turn protein finds for uch purposes. I sen in consult once from infective diet and increase of protein dies not miterally affect the retention of min an

While the ext runnuts of both Kru, and Dapper induste that an merca e in the cirbohydrate ration and a relatively greater merca e of fat are accompanied to a retention of introgen in I war animals the fact has not vet been e table had for money pt in typhoid for r Typhoid fever pitients may retain nature in during the course of the di case and in convides one when the diet firm h an excess of loth early hydrote

and fat (Shaffer and Coleman)

Con ral chinest exp mener apprars to indicate that the most initial le het for an overfieling curs is rich in 1 th fat and sirl divdrate

of alveogen and fut Young children, on the other hand, do not bear stirvation well even for hort periods. The receive supply of glyco...on is relatively small, and is soon exhausted. After its exhaustion, the body derives all of its energy from protein and fut. Lut, which is of ke er importance is significed in favor of protein. The heavy demand made mon the fut results in its meaninglete combustion and the occurrence of acid sis with actions bodies in the blood and arme

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are asleep or in coma

I oss of weight is characteristic of startation. It is due to the con sumption of the body to mes and to the elimination of water and silts As the weight dimini has the expenditure of energy falls, the fall, accord ing to lanbur corre ponding to the loss in weight. The body tempers ture remains ar actically con tant. The urine is dimon had in amount The los of introden is large for the first day or so, after which it remains fairly constant (10 to 13 crims) for a week or ten days. Material divergence from the changes indicates the influence of draise. However, in loughfuls factor other than the simple sparing of the abrect effect of food come into play

Benedict his hown that recovers from stars ation is rapid in health and may be followed by an actual _am in weight 1 ting for short periods appears to stumilate the body to mereast its store of fit. This

is regarded by benedict to be a protective mechanism

Effects of Partial Starvation - Partial startation may occur through force of circumstances such as poverts, or as the result of disease. In the latter case it is not always easy to distinguish between the influence of insufficient food and that of the disease. From the medical standpoint partial starvition probably occurs with greatest frequency in prolonged febrile and in milignint di erses

The body is capable of regulating its expenditure of energy to once extent When the food supply is insufficient the production of energy falls correspondingly But you Noorden believes that the minimal amount of energy required by persons who are bedridden or who remain indoors and do but little work amounts to from "O to 32 calorus per kilogram Their diets should be arranged upon this basis Persons who are under fed economize their protein at the expense of the less important fit The longer the deprivation of food continues the smaller the relative amount of protein consumed

of the urine rose at once Therefore since but little protein is absorbed and since, proteins are readily decomps ed by the intestinil flora, giving rise to substances which way irritate the bowd, it appears to be undesirable to give nutrient enemata containing protein even in its partially dure ted form.

There is a difference of opinion regarding the absorption of fat Brown was unable to prove the absorption of emulvified and panercatized fats when given by rectum to a patient suffering from children though when fat was taken by mouth the amount in the tirine was promptly in creased. Bood, on the other bund has shown that fat may be absorbed though be called statement on the wide differences in the absorptive power of different individuals. Bood recommends wilk of eag and emulsified obve oil as suitable fats for unirent enematr. Cream has also been used

Destrose is readily absorbed by the large intestine, and is probably the best form in which to give eurobolderite. Destrin has also been recommended. Brug-ch states that destrinated or milted starch is les irritating than the sugars and may be employed instead of them. Brown was able to raive the respirators quotient by the use of destrose and to cause the diministion or disappearance of audosis. Dixtro o may irritate the lowel and cause cramplike pins when given an concentration gruter than 10 per cent. I have found it nece sary at times to reduce the strength of the solution to 7 per cent and even to 5 per cent. If angar is absorbed by the inferior bemorthoodal yours it enters the general circuit ton without pussing through the layer and may cause given una

Salts and water are readily aborted by the colon and there is little doubt that much of the benefit which has been ascribed to nutrient chemita was attributable to these substances. Alcohol, likewise, is readily aborted, and is often added in an ill quantities to enemate

Method of Giving Autrient Farmata — Veleaning enema of normal sult solution (0) per cent) should be given exter morning on hour before the mitrent enema. Some mithors recommend a cleaning enemi before each nutrient enema. Some mithors recommend a cleaning enemi before each nutrient enema. But unde a the nutrient enema continuis Gods which are not readly al sorbed this procedure servedy seems neces any and may mercase the irritability of the colon. The pittent hould be placed either upon the left side or the back with the hips elevated on a pillow. The apparatus may consist of a medium user faunci metred into the end of a small rectal tube or large eatheter or an inverted thermos bettle connected with the rectal tube or ratheter by means of rubber tubing. A small metal tube passed through the stopper and reaching to the 1 stiom of the lottle permits the cutrance of air and its flow of its contents. A ballbearings is not suitable because of the difficulty of controlling the pressure, and the likelihood of injecting air. The fininel-apparatus is per high means of conceining for theker enemats, the lottle for the sugar solu.

Voit or Atwater standard should be followed in determining the amount of protein. In all cases the total energy requirement of the patient should be calculated and the dict arranged to furnish more energy than the calculation calls for

While the pathological effects of overfeeding cannot be considered at length, attention should be called to the fact that impulsions overfeeding may cause pathological obesity

### METHODS OF ARTIFICIAL FEEDING

When for any reason patients cannot or will not take food by mouth, other methods of nourishing them must be employed

Rectal Feeding—Rectal feedin, may be resorted to when swallowing is difficult or impossible as in exces of tumor or stricture of the throat or esophagus when the muscles of degliution are paralyzed, in cases of ulcer or tumor of the stomach, and in cases of uncontrollable vomiting. When for any terson patients are incipable of taking all the food they require by mouth, additional food may be given for brief periods per rectum.

The nutritive value of nutricut enemata has, according to recent in vestigations, been greatly overestimated, and the phistenian should keep clearly in mind the fact, when employing this method of alimentation, that the patient is receiving only a portion of the food he requires. Patherns have subsisted upon nutrient enemata for several weeks, but it has been largely at the expense of the loady it sues. The gains in weight which have occurred, especially after severe hemorrhages have been shown to be due to retention of water. Probably the greatest quantity of food which a patient is cyphile of absorbing by returning the case when at rest in bed Boyd calls attention particularly to the fact that the amount of food absorbed depends upon the patient as cypicity for ab orption and not upon the quantity of food injected. Therefore, it is not always desirable to give large enemata, the unused portion is likely to decompose and cause viriation.

Nutrent enemata do not enter the cleum, and such absorption as occurs must be from the colon Nor do nutrient enemata cause a reflex secretion of gastric juice (Pavlov)

The different foodstuffs are not absorbed with equal facility by the colon. All of the available evidence indicates that protein is poorly basabed. Brown compared the introgen output in the urine from saline and intrincit enemata, and observed not only that the curves were similar, but that they were comparable to the introgen everetion of healthy fasting men. When the same amount of food was given by mouth the uitrogen

in such each oftener than ones or twice a day. In the eace of per ons who are concious food may be given three times a day

Only liquid foods are notable tor _ivis_c. The 'small bould be made up (is to bulk and energy value) according to the frequency with which it is to be repeated and shall be warned to about the balk tenperature. Milk, eream, eggs and in, its are bet adapted to the includand may be employed in the following a similar mixtures.

MINTERS I ILLER CANACE

1 4	Q ttr	CII
Vilk	lint(sillee)	3.0
ream	1pmt (00 e e)	1 000
la tose or canceugar	Harama	200
		1 000
Milk	1 pint (>00 c c)	3.0
Crenni	1 tuit (%00 e c)	100
t gray	,	100
		1 010

Substitutions Feeding—Fat I calls first support tell the subsects necess administration of oils and fats as a means if supplying, the body with nutriment. Wills be recently anode in extended study of the nutled in I inch is laboratory, and the following statements are by ed upon his results.

This which are similar in composition to that of the body are me tredity at orbid. I mulsions at also whed better thin plan oils. The it tennism is made with from to percent of e.g. betthin and straid water. The sit of the injection bodd is straids it with timeture of rodin and should be not signed gratity afterwird. Care should be than to wood entering a vern as certified a point in it is about the tools in would be utility to desire the first point in the about necessary of grain of oil mix by given at one time without causing discountry. Mills have proved that fats introduced about meson by may be bound directly thus spaced that fats introduced about meson by may be bound directly thus a beretuned in the body in their own form or may be reconstructed into to bely fat.

The substitutions administration of fat should not be employed and so the pittort is expelle of taking for 11 month. While the medical hell produce of 1 mg in oful at how in been perfected sufficiently to permit of its recommendation for coveral purps, es-

I rotem out Surre—Whili numerous attempts have been mid to administer proteins and sugar abent meon by the methods hitherto employed have not proved practical. Native pretiin solutions are difficult.

FORMULE FOR NUTRIENT PARMATA

Nat t	1d g M	C 1 ies
Dextro e Water	20- 30 grams 200-300 c c	≈0-1°0
Dextro c Wine (white or rel) Water	20- 30 truns 15- 30 c e 200-300 c c.	80-120 10-20
Sons recommends		
Milk	200 c c	170
lolk of ega	9 1 pmch	100
Wine	loce	10
Flour	Lo grams	56
Myer recommends	1	ĺ
Cream	2,000	r00
Pertone	2 grams	1 1
Pancrestin	→ grams	1

tion. The rectal tube should be oiled, freed of air by allowing the enema

The size of intricin commit varies from 6 to 10 ounces (200 to 300 cc), the larger the commit the less frequent the need of repetition. They should be given at temperatures of 9.5 to 100° I. Autrent enemate should always be injected slowly. The flow may be regulated by raising or lowering the continuer. The sugar solutions are often given drop by drop, after the Murphy method. It is rurely advisable to give more than three enemats a day.

The patient should be in tracted to remain quiet afterward and to resist expul ion of the cuma. Tressure upon the perintim with a folded towel by the attendant will often enable the patient to return it which other will be it would be rejected. When the colon becomes irritated 10 to 20 drops of lindimum mix be added to the cuma in order to quiet the nervous reflexs set up by the irritation.

Gavage—the term gav_bo' des_unites forced feeding through an esophaged time. The tuke may be presed through the month or the nose Gavage, is especially undested in the case of his tercul or psychopythic patients who refuse food. It has also been employed in structure of the coplargue, whether sparsmodic or occure in parities of the mit cles of deginition, and in comas. The practice of gavage, is not musticated by danger, since the tule may enter the lurium especially when the patient is unconscious, and cau e pneumonia. Food should not be administered.

value of the food should not be permitted to fall below, nor to greatly exceed, the daily requirement of the patient

In addition to its employment in nephritis the salt poor diet has been recommended for the edema of chronic cardiac valeular discase, for the acutes of cirrhosis of the liver pleurist with effusion arterial sclero is, and diabetes instrudus

	0 <b>P</b>	Foots	
	SALT CONTENT OF FOO	era	

	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
	PCt		PCt 8dm
Feed	Chi d	Food	Chi di
	หน้า		Raw Mitril
Meats		Sm ked and Salted Foods-	
Mutton	014	Macketti ( alt, dre-sed)	10 40
Veal	0 13	Salmon (smoked salted)	108"
Calf's brain	0 0	Sardines (French in oil)	134
Calf's kidney	0.35	Cod liver oil	0 17
Calf's liver	014	Gelatju (dry)	0~ي
Beef (lean)	011	Beef marrow	0 11
I ork (lcon)	010	Sausages Fronkfurter	2 90
Venison	0 11	Sau iges various kinds	2 00-8 10
Lish		Inchovy paste (Cross	4
Trout	0.12	Blackwell)	401
Halibut	0.0	Mest Extracts	
Herring	0.2	I ietig s	2 00
Cod	0.16	hemmerich	1 40
Carp	0.090	Various louillon capsui	
Salmon	0.001	extract etc	9 40-00 0
Mackerel	0.001	I repared I cods	
Had lock	0 39	1 lasmon	0.21
Oyster (wa hed)	0.52	Polorat	0 0051
Oyster (with sea water)	114	Sanatoken	04)
	• • •	Somato e	0.68
Poultry		Bovril a preparations	0.26-141
Duck	0 14	Valentine a Meat Juice	0.09-1.20
Coo e	0.00	Feg (white an I yolk)	0.91
Chicken	0 14	Igg (white aline)	0 31
Pigeon	01. 017	Frg (yolk alone)	0.039
Turkey	014	Caviar	3 00
Smoked and Salted Foods		Milk (whole)	0 16
Ham (raw)	4 15-5 %	Cream	0 13
Ham (boiled)	193	Puttermilk	0 16
Salmon (*moked)	- 50	ll ber	011 - 015
Pacon (smck d Cerman)	1 01	Cond n ed Milk	0 40
Bacon (sm kc] \merican		Butter (un alted)	100-00
Corn beef German	9.05	Butter (salted)	1 00-3 00
Corn beef American	11 '	I canut butter *	4 10
Col (salt) *	°3 00	Oleomargarine	915
Cod (salt boneles.) *	19.00	Palmin	0.0016
Herring ( moked) *	11 ~0	Fructin	0 10

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to sterilize proteoses and peptones are totic. Solutions of glucose cause prin, and may cause necrosis, when given in greater concentration than 5 per cent. The weeker solutions supply so little nourishment that the drawbacks to the method ontweigh its advantages.

### THE SALT POOR DIET

The diet of evalued man contains ordinarily from 10 to 15 grams of common silt. This amount is readily exercted by normal kidness in twenty four hours. In one case of neghritis, however, especially the of the pireuchymatous type the kidness are unable to exerct more than 2 or 4 grams or even k so of salt a day. The salt which is retuned passes into the tissin fluids and causes, or more uses an existing edems. The mability of the kidness to exerct salt sometimes runs parallel with an inability of the vater.

The ever for power of the kidness for salt may be tested by a diet of 3 liters of milk (this contains) grams sodium chlorid and 100 grams protein) or ly Strings diet consting of V_i liter of milk, 4 eggs, 1.0 grams of bread and enough fruit, fruit juice, tea and sugar to make it pilitable. Straiss diet contains about 3 grams of ealt. If the kidness are able to everete the amount of salt contained in these diets, alt may be added to either of them in quantities of 5 to 10 grams. When the kidness are unable to eliminate the normal quantity of salt, some form of salt poor diet may be advised but it should be stated that the salt poor diet has not cutting lightlight the promises held out for it.

A salt free diet is a practical impossibility unless one follows von Noorden's plan of Living 200 grims of lactore only. The salt poor diets

have been grouped under three headings

The strict salt poor diet of Widal (containing 15 to 25 grams of salt) consists of salt free breid 200 grams, meat 200 grams, vegetables 2.0 grams, butter .0 grams and sugar 40 grams. This diet contains 60 grams of protein, and furnishes 1,700 enforces, which is nearly sufficient energy for the average patient restin, quietly in bed

The medium street duet contains from 25 to 5 grams of salt. The milk duet (3 liters) belongs here. The food should be cooked without the addition of salt, but the patient should be allowed to use 2 to 3 gram.

of salt 1 day at the table

The moderate salt poor dust (5 to 10 grunns) allows considerable last tude. It is not necessary to prepare special dishes, but the cook should be instructed to use sult sparingly. Salted foods such as broom and ham, should be prohibited. Thus dust furnishes only a rough control of the salt intake.

In administering a salt poor diet, it is important that the energy

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In addition to its employment in nephritis, the salt poor diet has been recommended for the edema of chronic cardiac valvular disease, for the ascites of cirrhosis of the liver pleurisy with effusion arterial sclerosis, and disbetes insipidus

SALT CONTENT OF FOODS
According to Leva

Meats   Mutton	Få	E 4 Cyl q D C r	F d	PCt Sdm Chld Rw
Minton		Mt I		Mini
Mintton	Meats		Smoked and Salted Foods-	-Cont
Veal		01	Mackerel (salt dressed)	10 40
Colf   London   Colf   Colf		0 13	Salmon (smoked alted)	108*
Calr   Ner   O14   Celtru (dr)   O75	Calfe brain	0.20	Sardines (French in oil)	134
Bed (lean)	Calf's kidney	0 >	Cod liver oil	0.17
Port (lean)	Calf's liver	014	(elatin (drv)	0~5
Port   (lean)   0.10   Sau uges Frankfurter   2.20   2.50   5.01   Sau uges Trankfurter   2.20   2.50   Sau uges Trankfurter   2.20   2.50   Sau uges Trankfurter   2.20   2.50   Sau uges Trankfurter   2.20   Sau uges Trankfurter   2	Buef (lean)	011	Beef marrow	0 11
Venion		0 10	Sau ages Frankfurter	2 20
Fig. 2		0 11	Sausages various kinds	
Trout			Anchovy pasts (Cross	3
Halbut		0.1		401
Herring			Meat Extracts	
Cot   Carp   Opt   Carp   Carp   Carp   Carp   Opt   Carp   Car			I rebig s	
Carp				1 40
Salmon			Various bouillon capsu	
Mackere				9 40-22 0
Haddock   0.39   Plasmon   0.21				
Oyster (ma hed)				
Oyster (with sea water)   114				
Poultry				
Duck				
Goose   0 *0   Egr (white and yoll)   Chricken   0 *14   Egr (white and yoll)   0 *15   Egr		0.14		
Chicken   014   Egg (write and you.)   071				
Pigeon				
Turkey				
Smoked and Salted Foods   Milk (whole)   0.16     Ham (traw)				
Ham (fraw)   415—856   Cream   0.13     Ham (boiled)   18.—35   Butteraulk   0.16     Salmon (smoked)   "0   Whey   0.11—0.15     Bacon (smoked German   1.01   Butter (unsalted)   0.00—0.91     Corn beef German   0.04   Butter (unsalted)   0.00—0.91     Corn beef American   11.52   Peanut butter   4.10     Cod (salt)   2.300   Oleomargarine   2.15     Cod (salt)   2.300   Oleomargarine		011		
Ham (boiled)   18.—, 35   Buttermilk   0.15				
Salmon (smoked)				
Bacon (smoked German   101   Condensed Milk   040	Ham (boiled)			
Bacon (sin ked American)   1161   Butter (unsalted)   0.0°—0.21				
Corn beef German   904   Butter ( alted)   100-300				
Corn beef American 1152 Peanut butter 410 Cod (salt) 4 2360 Oleomargarine 215	Com to C			
Cod (salt) * 2300 Oleomargarine 215				
	Cod (salt boneles ) *	19 00	Palmin	0 0016
Herring (smoked) * 1170 Fructin 010				

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The evertory power of the kidness for salt may be tested by a diet of 3 liters of milk (this contains 5 grams sedium chlorid and 100 grams protein) or by Strainss' diet consisting of ¾ liter of milk, 4 eggs, 150 grams of bread, and enough fruit, fruit juice, tea, and sugar to make it palatable. Strains' diet contains about 3 grams of salt. If the kidness are able to evertet the amount of salt contained in these diets, salt may be added to either of them in quantities of 5 to 10 grams. When the kidness are unable to climinate the normal quantity of salt, some form of salt poor diet may be advised, but it should be stated that the salt poor diet has not entirely fulfilled the promises held out for it.

A salt free dict is a practical impossibility unless one follows you Noorden's plan of giving 200 grams of lactose only. The salt poor diets

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The strict sall poor diet of Widal (containing 15 to 25 grams of salt) consists of alt free bread 200 grams, meat 200 grams, vegetables 250 grams, butter 50 grams, and sugar 40 grams. This diet contains 60 grams of protein, and furmishes 1,500 calories, which is nearly sufficient energy for the average patient resting quietly in bed

The medium strict diet contains from 25 to 5 grams of salt. The milk diet (3 liters) belongs here. The food should be cooked without the addition of salt, but the retrient should be allowed to use 2 to 3 grams.

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	SALT CONTEN	er of Foods	
	According	to Lera	
	P Cet		PC t Bd m
F 4	Chl d	Fo d	Chl di
	иt t		M t !
Meats		Smokel and Salted Foods-	
Mutton	0 17	Mackerel (salt dressed)	10 40
Veal	013	Salmon (smoked salted)	10 97
Calfs brain	020	Sardines (French in oil)	134
Calf'a kidney	0_0	Cod liver oil	017
Calf's liver	014	Gelatin (dry)	0.5
Beef (lean)	0 11	Beef marrow	011
Pork (lean)	610	Sausages Frankfurter	2 00
Venison	011	Sausages various kinds	2 90-8 10
l ish	V	Anchovy paste (Cross	
Trout	0 12	Blackwell	401
Halibut	0 30	Meat Extracts	
Herring	0 27	Liebig s	2 60
Cod	616	Kemmerich	1 40
Carp	0.090	Various bouillon capsui	ea
Salmon	0.001	ettracts etc	9 40-09 0
Macherel	0 29	Prepared Fonds	
Haddock	0 09	Plasmon	0 21
Oyster (washed)	0.52	Roborat	0 0051
Ovster (with sea water)	114	Sanstogen	0 42
Poultry		Some tose	0.66
Duck	014	Boyrd's preparations	0 26-14 1
Goose	0.90	Valentine a Meat Juice	6 091 °0
Chi ken	014	Egg (white and yolk)	0 21
Pigeon	015	Egg (white alone)	0 31
Turkey	0 17	Egg (yolk slone)	0 039
Smoked and Salted Foods	0.11	Cavar	3 00
Ham (raw)		Mdk (whole)	0 16
Ham (boiled)	4 15—5 % 1 8.—5 3.	Cream Buttermalk	013
Salmon (smoked)	750		0 16 0 11—0 15
Bacon (smoked Cerman)	101	Whey Conden ed Milk	040
Bacon (smoked America	n) 1161	Butter (unsalted)	0 09-0 21
Corn beef Cerman	204	Butter (salted)	1 003 00
Corn beef American	11 52	Peanut butter *	4 10
Cod (snlt) *	93 00	Oleomergarine	2 15
Cod (salt boneless) *	19 00	Palmin	0 0016
Herring ( moked) *	11 70	Fractin	010
			2.10

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### THE PURINTER DITT

## SULT CONTENT OF FOODS (Confe

. . .

Youk	Sd m Clad Bw Mtt	<b>)</b> 1
Drinks-Cont		Fork Little 1
Apolimaria	0.013	Sauce
Fachin or	009	Stimil 1
Care hubel (Mattern)	0.6021	Spinich
Ve hv	0003	Larrot
hoofs I repared for Table		( aulific w r
Le uillen	0 10	(reen salit
Tեւ k շորա	0.4	Ipple sin c
Raset becf	0.98	Steard 1133
Rosst porh	1 .4	Tapioes pathue (cu
Chops	09;	Macaroni (a la vaj fit
Po chicken	039	Luce with any his

## THE PURIN FREE DIET

Purn bodies preceive in the food and are form d within the body. The former are designated exogenous the litter ud an a purms. Both animal and we table foods contrain purms. Here of parts statistics in the physician are guarant admin by pointing a cutther are acid wifting (then) and theobround. The agent is of concar as parties are extended to the preceding and are proportion to the animal within but

## PURE CONTEST OF FORMS (RELAINED IN LIE) ACE)

### According to Calmar and Branch Balle Hall and Ha

accorn	ng to rekmit and D	BAR DARRE COM.	
10) Q m	L AMO m	10 to	2 to 1 10 m
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#### THE PURINCIPE DILL

### SALT CONTENT OF FORES (f 1 ftr 1)

Food	I C 4 S d m Ct i d M w M t i	ł t
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Apollinaris Fachin er	0 013	Same
t acute er	009	Srendl t
( 100 hubel (Wattom)	0.0021	Spana h
Vi hi	0.0.3	Carrot
Foods I repared for Tall Builton		Culifor
That	010	Creen, willid
Thick soups	0	Apple sauce
Ru theef	0.93	Studyear
Roast pork	1 54	Tart ca judding tin
Chopa	0.97	Ma arom ta la Na la
Roast chicken	0 39	Rice with apples

### THE PURIN PREE DIET

Furn bodies preexist in the food and are formed within the body. The former are designated evogenous the little random nonseparius. Both animal and accetable foods contain purios. How a degree it is interest to the phrasician are guantin, adeniu hapounthin winthin uric and differing (filters), and theobromin. The ingestion of evogen us purios rices the jurinecontent of the urine, and in proportions to the amount tiken but

# PURTY CONTENT OF FOLDS (RECNOSED 49 ( HK 1 1D)

		(	
iceordin;	g to Sel mul and Be	nau Balk Hall an	1 77 vae
Beef	t Add m	2 14 €	In A dG
Matten	0 111-0 189	Salmon	100 0-0 201
lork	0 0,80 191	Carp	U 1t
l'ent	0 123-0 14	Herring	n 20.
Ham (raw)	0114-0159		03 £
Tongue (call)	0 0 2-0 133	At h ry	041
Brain (11)	0 16.	Orsters	0.08"0 1
Iter (i i)	0034-02 1	Listr	9.00
hidner (1 (1)	02/9-032	Cavine	0 110
Thymus ( alf)	0 940-0 20		0.0.4
Chicken ( alt)	99,0-1 09	Spins h	0 0 2
Ligeon	0.05 0.180	ta w	0.01
Goose	01:4-0154	1 paragus	00 100-
1 enison	0 099	Stran bem	0.006
Poullon	011"0197	Potators	0.000
West Frinci	001 011	Mu hroorus	0.01 0.019
Trout	2 000 000	I as	001-009
Shellf h	0 13	Lentils	710-0
Cod	0 11	Reens	0 0 10 093
-	0.05 0.131	Ostmeal	0.0/4

less is excreted than is ingested. The excretion of endopenous purins is essentially constant for each undividual

The use of the purin free diet is based upon the theory that gout and some other disorders are dependent upon the retention of uric acid in the body The diet has also been employed in discases of the kidney, for ome headaches, and "bilious attacks" (Proof is lacking, however, that the diet possesses definite value

### FOODS CONTAINING NO PURIS

Bread	Beets
Cereals	Onlons
Fruits	Port
Eggs	Sherry
Milk	Bordeau
Cheese	

### PURIN CONTENT OF REVERAGES

ccoraing to naixe	er Hall and Labbe	
Pu n Bode Reckon d Ur A d in G m Chefy Methylpu s	100 G ams	Purn Bd a Reck da Urc Adi Gm Ch fir M thylpu a
1 24 1 32-3 58 1 43 1 30 0 016	1 Cup tea (Ceylon) 1 Cup tea (Indian) 1 Cup tea (Chinese) 1 Cup coffee 1 Cup chocolate	0 0805 0 0700 0 023-0 048 0 110-0 °50 0 268-0 372 0 130
	Pu n Bod e Rection d Ur A d in C hear C hear Methylyu s 124 135-358 143 130	Pn c Bed c Urclean   100 G ams C ed   1

### PURIN NITROGEN CONTENT IN PER CENT

	Fron	. Vogel	
	Put n N		Purin N
Beef *	0.059	Oatmeal	0 030
Beef liver	0 099	Rice *	0 0004
Beef thymus	0 398	Potatoes *	0 001
Cod *	0 040	Spinach *	0 022
Wheat meal	0 001	Milk	0 0002
White bread	0.003	Swiss Chee e	0 0004
White bread*	0 005	Egg	0.0
Hominy	0 004	Tomatoes *	0.0

Foods b ught in America

### METABOLISM IN FEVER

Total Metabolism -The loss of weight, which until recently has dwavs accompanied prolonged high fever, early led to the belief that the intensity of the metabolic processes in fever is increased. This belief remained unchallenged for many years in fact, until attempts were made to calculate the heat production of patients with fever from measurements of the respiratory exchanges

The increase of the mitro-en exerction in the urine has generally been accepted as indicating a more rapid destruction of protein. The discussions have centered around the total heat production and the extent to which carbohidrite and fat participated in the metabolic processes

which bring about the increased heat production

A rise, of the bod temperature may be brought about by an increase, in the tarpoduction without change, in heat elimination by a decrease in hert elimination the heat production remaining unchanged, or by other disproportional alterations of heet production and heat elimination. In probably no disease does the heat production reach such levels as nor mally occur during violent und prolonged muscular evertion yet the body temperature is not affected by it. In cophitalizing eighter the metabolism may be 75 per cent above normal without producing fever. Therefore, it is evident that uncreuse in heat production alone is not sufficient to cause fever. The heat regulating mechanism must be altered. It is 'set' in fever for a higher level of body temperature just as a thermostat is set for a higher temp riture in an incubator.

Quantitative Changes —Th. total hest production of the body may be learned by direct mensurement of the heat given off (direct calorimetry) or be extendated from the respiratory exchanges and the nitrogen of the unne (indirect enformetry) Du Bois has shown with the aid of the calorimeter of the Russell Sa_e Institute of Pathology that the two

methods agree within 2 2 per cent

The earliest studies of the total heat production in fever by indirect colorimetry give inconstant results. In the majority of cases an increase was noted but other cases were observed in which it was normal or even decreased. As a result of these disforences the theory was advinced that fever might occur without increase in heat production, that is from decrease in heat climination. But the results obtained in the investigations of Coleman and ID a Pois and the fact that mans of the carlier observations have been proved innellable inclined the author to the belief that favor is always accompanied by increased heat production. There has always been an increase during the febrile period of typhoid. The total metabolism was roughly parallel to the temperature curve, though there were considerable varietions in different patients and in the same patient at different stages of the disease. The average increase amounted to 40 per cent the maximum to something over 50 per cent.

Without entering into the di cu sion of the significance of fever in the infective diseases, some of the factors to which the increase in heat product on his been attributed require consideration

An ea ly explanation ascribed the merca e to the greater destruction

of protein. This theory has been abandoned except in so far as the protein metabolism contributes to the general increase

Fr Mueller suggested that the increase in metabolism might be due in part to the increased rapidity of the heart and respiration and to muscular effort-restlessness, rigors Tho most recent studies indicate that the amount of energy liberated by the heart and muscles of respiration is insignificant when compared to the total, at least, it plays no con siderable part in increasing heat production in fever. In typhoid the pulse is characteristically slow. But few ob ervations have been made on the amount of energy required to perform muscular work in fever Svenson found in convalescence from typhoid that muscular work is not done economically. It may not be done economically during the februle period, yet according to evidence which we possess the increase in total metabolism is greater than could be accounted for by restlessness. A patient was unusually quiet during the first hour of a three-hour period in the calorimeter during the second hour be was restless and tossed about the bed, during the third hour he was restless and irrational Yet during the whole period his metabolism was only 43 per cent above normal, and was only 5 per cent higher than it was during a quiet observation made two days later when the temperature was lower. In the typhoid state, when the patient is rarely quiet, the increase in heat production from muscular effort must be great-it is conceivably doubled In the ordinary case of typhoid the amount of the increase from moving about the bed has been estimated to be about 10 per cent

The influence of food upon the total metabolism during the febrile period is negligible. The increase from protein is 5 per cent, from carbohydrate 1 per cent. In convalescence food has caused an increase of 10 per cent in heat production, but without affecting the body temperature

Qualitative Changes — When the introgen of the urms is known, the amounts of protein, carbohydrite, and fat consumed during stated periods may be calculated from the O consumption and the respiratory quotient. The respiratory quotient, or coefficient, is the result obtained by dividing the CO output in the O consumed

By reason of its chemical composition, when carboh dirate is oxidized to earbon diovid and writer the amount of CO hiberated and O consumed are equal and the respiratory quotient is 10. When fat is oxidized to the same end products the respiratory quotient is 0.7. When protein so oxidized to urea the quotient is 0.8. When the holy transforms carbo hidrate to fat the quotient is 0.8. When the holy transforms carbo hidrate to fat the quotient is 0.9 and it is proved in the protein is constantly metabolized, the respiratory quotient may vary from something over 0.7 to somewhat under 1.0. When the body is storing fat the quotient is slightly under, or over, 10.

The respiratory exchanges of fever patients have been studied both

during the fasting state and after food. The data which have been ac cumulated permit a reasonably clear conception of metabolic processes in fever to be formulated.

The low respiratory quotients that is, under 0.7, which have been obtained by some observers, and which can only be interpreted by assuming that profound changes occur in the metabolic processes in fever, are now attributed to errors in technic

As will be seen later, the nitrogen metabolism probably is increased But no qualitative clange in the nitrogen metabolism his been observed Protein is ovulazed to the same and products as in health—urer principally—and liberates the standard amount of heat per unit of substance No qualitative clanges are known in the metabolism of carbohydrate and fat Both are oxidized to carbon dioxid and water and similarly, produce the calculated amounts of heat. The law of the conservation of energy obtains in face as well as in health.

The respiratory quotients prove that carbohydrate and fat are metabolized under the same menril laws as in health—only the rate of utilization is changed. When available carbohydrate is consumed in preference to, and in greater quantity than, fat, just as in health when as increased dimend for energy has to be met. When carbohydrate is not available, fat (of the food or body stores) is utilized. It is still doubtful whether fat is as capible of protecting body protein as is carbohydrate. In a mixed diet they appear to be equally good as protein spirors within limits which have not yet been determined. The carbohydrate supply is more rapidly exhausted in fever than in health whether in the form of the unchanged carbohydrate of the blood or the glycogen of the tissues, and should be frequently replenshed.

Nitrogen Metabolism—On low diets the nitrogen metabolism is al ways increased in the infective fevers. More nitrogen leaves the body in the urine than is taken in with the food. Consequently the store of nitrogen is constantly depleted the patient is said to be in negative nitrogen bilince. In severe forms of the infective fevers, such as pneumonia and typhoid, the loses relatively speaking may be very great. In general, the extent of the loss is proportional to the soverity of the

infection It is always greater thon in simple starvation

This loss of nitrogen in the infective fevers has been known for many vers and has been called the febrile or toxic destruction of protein lecordingly it has been considered a characteristic phenomenon of infective fevers

Steral conceptions of the nature of the process are found in the extension literature, on the subject. Non Levden and Klampeerr describe it as a loss of introgen within cannot be presented by food. According to Incident and Surany, it is noted, an expression of the increase in total metalolism. Krebl and Ir Mueller use the term to indicate direct

injury to the cells of the body by the toxin of the infecting organism These different conceptions have led to much confusion in discussions of the subject It should be stated here that Grafe and his pupil. Rolland. deny the existence of a toxic destruction of protein in fever

By their success in bringing pitients with severe attacks of typhoid fever into nitrogen equilibrium Shaffer and Coleman showed that the

conception of von Levden and Klemperer is no longer tenable

The main objection to the theory of Benedict and Surinyi lies in the fact that the nitrouen metabolism of normal men does not rise with the merease in total metabolism which occurs during muscular effort. More over the increase in nitrogen metabolism appears to be greater than can be explained by the increase in total metabolism in fever

Krehl's theory of the toxic destruction of protein is at present the center of active discussion The opponents of the theory, when not deny ing its occurrence, maintain that the increase in nitrogen metabolism is due to the rise in the body temperature rother than to an injurious ac ion

of toxins on the cells

Influence of High Temperature - A large number of experiments have been performed on lower animals and man in the attempt to dis cover the extent to which nitrogen metabolism is influenced by high cover the extent to which introgen increasing is inimeted by many temperature. The body temperature has been raised artificially by puncture, of the hert center has hot uir, hot water, and steam baths and the utrogen output determined. The introgen output of patients with various types and heights of temperature curves has been studied during the febrile and afebrile periods

The results of these experiments have not been uniform. Senator ind Richter explain negative results by saying that increase in the metabolism of protein occurs only when the high temperature is main tained for a number of hours and that the increase of nitrogen in the urine may not at once be apparent. Graham and Poulton experimenting upon themselves did not succeed in increasing the nitrogen output

by raising the body temperature by steam baths

The observations in virious fabrile diseases and on experimentally infected animals have been equally inconstant. In some instances the nitrogen exerction has purilleled the temperature curve, in some it has been high when the temperature has been low and an increa e in the nitrogen excretion has been observed before the rise in temperature oc curred Tinser and Schmid tate that the natrogen exerction is affected only by temperatures of 39° C and over

Influence of Torins—The discrepincies in the relation of the nitrogen exerction to the body temperature led to a search for other causes Arehl attributes the increase in nitrogen metabolism to a deleterious action of the toxin of the invading organism on the cells of the body

Commenting on May's experiments on animals Fr Muclier says the

fact that carbohydrate diminishes the protein loss in fever would not disprove the theory of a toxic destruction until it had been shown that like amounts of carbohydrate reduce the nitrogen exchanges of men with high fever to as low a level as in health. Shaffer and Coleman have hown that this is impossible in typhoid fever. Their patients could not be brought into introgen equilibrium until they were given amounts of food representing an energy value of #0 per cent to 100 per cent above their light production (computed from measurements made later with the Penedict "universil' appearins and the Sign calorimeter) It was allo found that the introgen intake could not be reduced much below 10 grams without throwing the patient out of nitrogen bilance Rolland's patients with sepsis, paratyphoid and sente pulmonary tub realesis had a natrogen metabolism not greater than the lowest requirements in health. Sho brought them into bilance on amounts of protein slightly greater or within the figures civen by Rumpf and Schumm (1 15 grams per kilo gram) and by Chittenden (0 7 grams per kilogram), but with an excess of carbohydrate. She did not take the nair gen minimum into consideration that is the smallest amount of mirrigen to which a healthy man can be reduced for short periods, together with sufficient amounts of carbohydrate and fat to cover his on rgy requirement without developing a negative nitrogen balance

Recently Koeher, working under Fr Muellers direction has made a filter study of the subject. He compared the effect of an increase in the total metabolism (through str mious excrease) of two healthy individual upon their nitro, a minima with the integen excretion of fever patients on dicts continuing e-suitally the same quintities of protein and amounts of energy which he calculated were sufficient to bring them mio nitrogen equilibrium. Since the fever patients both integen, while the healthy men did not, he concluded that the occurrence of a town destruction had been established. Koeher's experiments are open to the objection that he did not first bring his patients into equilibrium and then reduce the protein as Shrifer and Coleman did. Graft has published experiments on animals which he claims disprove Koeher's conclusion

The author believes that the protein metabolism is mercused in the infective fivers. The fact that typh id patients cannot be brought into intragen equilibrium unles they receive from 10 to 15, grims of introgen a day and an amount of energy from 30 per cent to 110 per cent greater than their heat production can in his opinion be interpreted in no other way. But whether the unexase in protein metabolism is due to the clevation in temperature or to injury from the twins is, likewise in lies opinion an open quickion.

The most important consideration for the practitioner is that it is possible to nourish fiver patients in a manner which prevents loss of mitrogen to the body minry to the cells of the body by the toxin of the infection, organism These different conceptions have led to much confusion in di cussions of the subject It should be stated here that Grife and his pupil, Rolland. deny the existence of a toxic destruction of protein in fever

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from 50 to 110 per cent more energy than the heat production. This is probably true for many infective fevers. There is some disagreement whether patients should be given such large amounts of food, but patients digest them well, and the author can see no justification for permitting a gratutions los of protein. Expressed as energy, patients with severe fever require from 3,000 to 4,000 calonics a day. If they complain of hunger, as typhoid patients frequently hive while taking this amount the food may be increased. The author has permitted as much as 7,600 calonics.

The amount of protein which the patient needs varies from 60 grams to 90 grams. Patients lose nitrogen it less than 60 grams be given, and they

derive no benefit from more than 90 grams

Carbohydrate is consumed in preference to fat, whenever it is available and should be the main rehance for maintaining, the energy value of the date. When the desired amount of carbohydrate is not easily digested, the quantity of fat may be graduilly increased. The virangement of dietaries will be simpler if fat is included (butter sud cream) and with some patients it must be depended upon to supply the greater portion of the energy. As much as 300 grams of fat a day has been given.

One of the most important considerations in the dieting of fever pitients is individualization. Ever- effort should be mide to feed the fever,' but this can be accomplished only if the patient digests and absorbs the food he receives. With so many foods from which to choose, it will rurely be necessary to insist upon a patients taking foods he dislikes. It is desires should be followed as far as its feasible both in the selection and pr paration of his food.

Loods which disagree should be avoided. Torrey has hown that the mability of the typhoid patient to digest his food is associated with a fredominance of a putterfective flor; in the intestine. The equally important fact disclosed by his investigation, was that favorable former titue types of organisms usually guin the ascendency on diets rich in earlohidrite.

Much greater variety in food may be allowed than was formerly

thought permissible

The author his prictically abandoned the use of the milk det except for brief periods and under unusual circumstances. Milk is a valuable addition to many dictaries but alone it furnishes too much protein and too little energy. If a extbodydrate is taken with it, such as breid crackers, simple cake it is not only more easily digisted but patients enjoy it more. Milk may serve also as a vehicle for other foods—milk segar, e.g., and cream.

The food should be served as far as possible in the form and manner most likely to stimulate the patients desire for it. Small quantities at

Absorption of Food in Fever -- Von Hoeselin found in 1882 that food is absorbed by typhoid patients almost as well as in health, in spite of the fact that most of his patients suffered from diarrhea About the same time (1883) similar observations were made in Chudnowsky's clinic in Russia Von Leyden and Klemperer's patients with high fever lost in the stools 6 per cent to 11 per cent of fut and 9 per cent of protein No carbohydrate was lost except when large amounts were given or the patients had profuse diarrhea. Recently Du Bois has reinvestigated the question of food absorption in typhoid fever, using more reliable methods of analysis He found the losses to be as follows. There was no loss of carbohydrate except when the patients were taking more than 300 grams a day, then it amounted to only 2 or 3 grims, the average loss of protein was 7 per cent, the average loss of fat for all tages of the disease was 6 per cent (the loss of normal controls on the same duet was 3 per cent). for the early stages the loss was 7 per cent, for the later 4 5 per cent It should be added that the patients were taking large amounts of fat In Coleman and Gephart's typhoid patients the average fat loss in all periods of the disease was 4 3 per cent. No differences were observed between the early and later stages. The nitrogen losses averaged 11 por cent

These observations prove that in typhoid fever, and probably in other febrile diseases, the absorption of food is nearly as complete as in health

# Fever Diet

The facts which have been obtained through studies of metabolism in fever have removed all doubt that petients with fever require more food than healthy men, unless engaged in heavy labor. The only question is whether fever patients can take the amount of food they need without detriment. The answer is to be found in chinical tests, without which it is impossible to estimate the value of any thrapeuton procedure. These tests have been made on a large scale, and the results prove not only that fever patients can take without having the amount of food they need, but that they are hencified by doing so

Diets which do not furnish enough energy to cover the patients beat production compel them to live in part at the expense of their own tissues Experiments with such diets extend back some 2,000 years in medical history, and the results to say the least have been disappointing and the old doctring of starring a fever' is fundamentially erroneous

The food needs of the fiver patient may be summarized as follows

The total energy required is always greater than in health. In general, the higher the temperature, the greater the need for food. In typhoid fever the body protein is not protected unless the food furnishes

Toast Water (Cantlev) -- I our a pint of boiling water over two or three slices of well toasted bread I et it stand until cool, strain.

The calory value of this preparation is negligible

Chicken Broth (Partholox)—Skin and chop fine a small chicken or half of a large fowl and boil it bones and all, with a blade of mace, a spin, of paraley, and a crust of breid, in a quart of water for an hour kinding it from time to time in order to remove the excess of fat from the bruth. Struin through a course colouder

The composition of chicken broth is 84 3 per cent water, 10 o per cent protein 0 8 per cent fat 24 per cent carbohydrate 2 per cent ash

It furnishes 56 calories to 100 c c

Chicken Jelly (Advins) — Ch in a fowl that is about a year old remove skin and fit chop bones and flesh fine, place in a pan with two quarts of writer, heat slowly skim throughly summer fite to six hours add salt mace or pursley to taste struin, and cool. When cool skim off the fat. The July is usually reshold old but may be heated. Data for estimating the callory value of this preparation are not available.

Beef Tea (Cuttley) -1 Unnec one pound of lean beef and add to it one pint of cold water and ten drops of dilute hydrochloric neid Let it stand for two or three hours with occasional stirring, and then simmer

for ten to twenty minutes Do not let it boil Skim well
2 Minco one pound of lean beef as fine as possible, and pound it in a

morter with a small terapoonful of selt. Add the meat and its juice to one pint of witer at 170. For an earther, essels and stand at for an hour by the fire stirring at times. Then strain it through muslin, taking cire to squexze sill the juice out of the meat.

The composition of beet face is 929 per cent water, 44 per cent.

The composition of beef that is 929 per cent water, 44 per cent protein, 04 per cent fat 11 per cent carbohydrate 12 per cent ash

It furnishes 25 calories to 100 c c
Invalid Broths (Thompson) —To one pound of chonned lean meat

either chicken mitten or beef add one pint of cold witer let stand in a concred glass frint jur from four to six hours, cook for three hours in a clased jur over a slow fire strain cool skim off the fat, clear with egg season and feed warm or cold

These broths except the chicken broth possess essentially the same

fuel value as beef tea

Beef Junes (Bittholow)—broal quickly some pieces of round or sir loun steels of a size to fit in the cavity of a lemon squeezer previously heated by dipping in hot water. The junes should be received into a hot colored (preferribly rid) wine gliss sersoned to tasto with salt and cavenum peoper, and taken hot

Beef June ((Lauth v) — Chop lem beef fine or crape with a fork or meat scraper to separate the connective tissue and put it in a jar or cup, with a pinch of alt and enough cold water to cover it. Allow

frequent intervals—but not oftener than every two hours—are digested more easily than fewer, but larger, meals. In sever, fevers the patient should be waked for his food, except perhaps during the early morning hours.

The appetite may be stimulated and flow of gastric junce started by beginning the larger meals with two to four onners of meat soup

This amount will not compromise stomach room

The foods which the author has found most u cful are unth, creun, egs, bread or to ist erackers, well builed and bran free ecreals, rice, well cooked potato, butter, bacon (as a ribal), milk sigur, cinesingar, ten and coffee (as whicks and for variety), coco, apple sauce, or nige juice, lemonade, and grape juice.

Any digestible combination of these foods may be given (see Invalid s

Dietary)

The more crash digested in its may be permitted in small quantities once a day preferably it midday. Loods containing cellulo e may be allowed to patients whose alimentary tracts are not the sext of pathological processes.

#### INVALIDS DIETARY

Oatmeal Gruel (plum) (from Food) —Two tible poonfuls of gruun lated outneal (41 gruns, 154 calories), one caldspoonful of sell, one search tesspoonful of sugar (8 grun , 35 calories), one cupful of bollung water, one cupful of milk (100 gruns 216 cilories). Mix the otimeal, salt and sugar tegether, ind pour on the bollung water. Cook for thirts munutes, then strun through a fine wire strainer to remove the hulls place again on the stove, add the nulls, and heat just to the bolling point. Serve hot

This gruel furnishes 420 calories

Barley Water (C milex)—I him—I'nt a teaspoonful of prepared or parl barley previou ly washed in cold water, into a jug pour half a punt of bailing witer out a did a pinel of salt, stand it but he fire for an hour, stirring occasionally, and strum through fine mushin. Similar thin cereal decections must be made from rice, arrowroot, or outmit. If fur makes about 7 clusters per 100 ce.

Thick—Put a heeped tablespoonful of washed prepared, or pearl birley into a clean succeptur and add a quart of water and a pinch of sait. Boil slowly until it has emporated down to about two thirds of a quart and strain. It may be flyored as desired. The addition of a little lemon pice, while holim, is best

The composition of birles water is 0.09 per cent protein, 0.05 per

cent fat, 1 6 per cent carbolydrate

It furnishes 14 calories to 100 c c

Toast Water (Cautley) —Pour a pint of boiling water over two or three slices of well to isted bread. Let it stand until cool strain,

The cylory value of this preparation is negligible

Once Broth (Bartholow)—Shin and chop time a small chicken or half of a large fowl, and boil it bones and all, with a blade of mace a sping of parsky, and a crust of bread in a quart of water for an houskinming it from time to time in order to remove the excess of fat from the both Strin through a cover colludor.

The composition of clucken broth is \$4.3 per cent water, 10.5 per cent protein 0.8 per cent fat 2.4 per cent carbohydrate, 2 per cent ash

It furnishes 56 calories to 100 c c

Chicken Jelly (Ad mas) — Clem a fowl that is about a year old remove shan and fut, thop bones and flesh fine, place in a pan with two querts of water heet slowly sham throught summer five to are hours aid salt mice, or parsies to taste train and cool. When cool skim off the fat. The jelly is usually schelled cold but may be heated. Data for estimatin, the calory value of this preparation are not available.

Beef Tea (Cutiky)—1 Mines one pound of lean beef and add to it one pint of cold water and ten drops of didute hydrochloric acid. Let it stind for two or three hours, with occasional stirring and then simmer

for ten to twenty minutes Do not let it boil Skin well

2 Mince one pound of lean beef as fine as possible and pound it in a metal must be a fine it is appoinful of salt. Add the meat and its juice to one pint of water at 170 J m an earthen tessel and stand it for an lour by the fire stirring at times. Then strain it through muslin, taking curt to squeeze all the pince out of the mass.

The composition of heef ten is 929 per cent water, 44 per cent Protein, 04 per cent fat, 11 per cent exploited arter 12 per cent a h

It furnishes 25 calories to 100 c c

Invalid Broths (Thomp on) — To one pound of chopped levin meat either chickin, mutton or beef add one pint of cold water, let stand in a coursed glass fruit jur from four to as a bours, cook, for three hours in a closed jur over a slow fire, strain, cool, skim off the fat, clear with egg scas n, and feed warm or cold

These broths, except the chicken broth possess essentially the same

fuel value as beef tea

Beef Junce (1 utholos) —Broal quickly some pieces of round or sir loin steak, of a size to fit in the eavity of a lemon squeezer previously bested by dipping, in hot water. The junce should be received into a hot colored (preferably red) wine glass, seasoned to taste with salt and evicence peoper, and takin hot

Beef June (Cautler) — Chop lean beef fine or scrape with a fork or meat scraper to separate the connective ti sue and put it in a jar or cup with a pinch of salt and enough cold water to cover it. Allow it to stand from one to aix hours, and then squeeze well through coarse mush. It may be given alone or mixed with other foods, warm or cold—not hot — It should be warmed by heating the vessel in hot matter.

Beef Junce (Ringer) —Take one ounce of fresh leef, free from fat, chop fine, and pour over it eight ounces of cold water, add five or av drops of dilute hydrochlorie acid, and fifty to sixty grains of common sill, stir it well, and leave for three or four boars in a cool place. Then pass the liquid through a hair sieve, pressing the meat slightly, and adding gradually toward the end of the straining about two more omness of water. The liquid thus obtained is of a red color, possessing the trate of somp. It should be taken cold, a terspoonful at a time. If preferred warm, it must not be put on the fire, but heated in a covered vessel placed

The composition of beef juice is 90 6 per cent water, 5 0 per cent protein, 0 6 per cent fat

It furnishes 25 calories to 100 c c

Beef Pulp (Cantlex)—Serrpe a piece of raw lean rump or sirloin steak with a fork or meet scraper until as much as possible of the museu let rissue has been obtained, sepirated from the tendinous parts. Pound it in a morter to a pulp, and then rub it through a fine sieve. See son with pepper and salt. It may be taken in the form of sandwiches, or rolled up into small rasoles and lightly grilled or fried

Very little of the nutriment of the meat is lost in this process

Egg Albumn Water (Watson) —Take the white of an egg (30 calories) and to it add twice its own volume of water and strain through muslin. This gives about three ounces of a clear solution, containing as much protein as is found in the average sample of commercial beef twice.

This fluid, added to home-made beef tea, makes a nutritive solution almost indistinguishable from beef juice and at a fraction of the cost. Mix

while cool in order not to precipitate the proteins

Egg Albiumin Water (Conitice) —Take the white of a fresh egg (30

Ealories) and cut it in numerous directions with sensors Shake it up

in a firsh with a pinch of salt and ax onnees of cold water Strain

through muslin

It can be made with thin barley water, and cream or sngar added Egg nog—The following recipo makes a glass and one half of egg nog

Egg, 1 large (60 grams) Sugar, 1 tablespoonful (30 grams) Whisky, 2 tablespoonfuls	120 90	calories "
Creum, 7 tablespoonfuls	210	44

Add the sugar to the yell of egg and best until very l_klit Whip the white of the egg and then the cream until very stiff Add the wh ky to the yelk of egg and sugar Mix well Add one half the creum to this then one half the beaten white of egg then the remuning cream, and finally the remaining white of egg 'Mix lightly

Egg nog (Bartholou)—"cald some new mulk by puttin, it, contained in a jug into a saucepan of boiling water, but it must not be allowed to boil. Beat an ego with a fork in a tumbler with some sugar add of deserthpoonful of hrandy and bill the tumbler with the scalded milk.

when cold

This egg nog will furnish about 300 calories

Savory Custard (Anderson) — Add the volks of two eggs to a cupful of becf tea with pepper and salt to taste Butter a cup or a jam pot pour the mixture into it and let it stand in a ran of boiling water till the evistard is set

This will furnish 150 calones

Egg Flip—Boil or heat thoroughly a teacupful of milk beat the wither of one egg to a froth Pour the milk over the egg, stirring constantly Add sugart to taste

This will furnish 230 calories

Caudle (1eo) -- Bert an eg. to a froth add a glass of sherry and balf a pint of gruel Flavor with a lemon peel nutmeg and sugar The gruel may be made either with water or inith.

This will furnish from 120 to 1 0 calories according to the consist ency of the gruel If milk is used to make the gruel it will have a higher value

Boiled Ruce (U S Army Hospital Pecupe)—Ruce one ounce (30 grams) salt, twenty grams water four ounces Directions—Put the salt and water into a stewpan When boiling add the rice, proviously washed thoroughly Boil for ten munutes or until each grain becomes oft. Drain it on a colander Girase the stewpan with clarified dirip pings of lard. Put hack the rice. Let it swell slowly near the fire, or in a slow oven for about twenty minutes until the grains are well separated.

Boiled rice furnishes 60 calories to 1 toblespoonful

Rice Pudding

Rice 3 tablespoonfuls (100 grams) 360 calories Viik 1 quart 700 "

Salt 1 pmeh

Wash the rice with water of the stove for one hour, or a little longer, until the mixture becomes creamy

Add Sugar Butter

1 cup (280 grams) 1 hearing teaspoonful

1.148 calories 100

Cumamon nutmeg, or vanilla to taste

Put into a dish to set and lake in an oven until the ton is brouned The whole pudding contains 2 32 > calories It furnishes five to six partions

Rice Pudding (Cantley) -- Cover the bottom of a dish with cleri rice, nearly fill with milk, and add sugar, put it in a slow oven for three hours, and in the hottest part of the oven for fifteen minutes

With the indefinite statement of the amounts of the incredients, the

calorie value of this preparation cannot be estimated

Rice and Egg Pudding (Cauties) -Take three onners (90 cross, 315 calories) of rice and swell it gently in one pint of new milk ( 350 calories) Let it cool, and stir well into it one owner of fresh butter (230 calonies). two ounces of powdered sugar (240 enlarges), the volks of three care (150 colories) and some grated lemon peel Pour into a well buttered dish and put on the top the wintes of the three (428 (96 calories), besten with three tablespoonfuls of powdered smar (185 calories) Bake for twenty munites until lightly browned

The whole midding contains 1 550 calories

Arrowroot (Pass) -Mry thoroughly two tenspoonfuls of arrowroot with three tablespoonfuls of cold water, and pour on them half a put of boiling nater, stirring well meanwhile. If the nater is quite boiling the arrowroot thickens as it is poured on, and nothing more is necessary. If only narm nater is used, the arron root must be afternard boiled until it thickens Sweeten with loaf sugar, and flavor with lemon niel or nut mee, or add sherry, port wine, or brandy, if required Boiling milk may be employed instead of water, but when this is done no wine must be added as the milk would curdle

#### Cones Innhat !

Cocor	1	teaspoonful	50	calorus
Milk sugar		gr ims	100	11
Milk, 5 oz	150	2.0	100	ш
Innket tablet	1/3			

1 oz Cold water

Dissolve the junket tablet in the water. Mrx the cocon and sugar, add the milk, and heat lukewarm, stirring constantly, add the dissolved junket tablet, stir thoroughly, and leave in a warm place to set

This and the folkwing recipes were published in the American Journal of Meli cal Sciences for January 1910

Soft Custard	* (0 )	100	calories
Milk	1 cup (8 oz )	100	calories
Egg	1	80	u
Milk sugar	60 grams	240	44
Salt	a speck		
Vanilla	2 to 3 drops		
Caramel, made			

of _ranulated sugar

3 tablesmonfuls 20 Beat the egg slightly add the sugar salt, and hot milk slowly Cook

in a double boiler, stirring constantly until it thickens a little (if cooked too long the custard will curdle but may become smooth again if set in a di h of cold water and beaten at once) Flavor and cool

To make caramel put the sugar in a pan directly over heat and burn until a very dark brown Dissolve in hot water or milk.

Plam Junket or	Rennet	Custard		
Milk sugar	2.	grams	100	calories
Milk	5	oz (150 cc)	100	**
Junket tablet	1/4			
Cold water	1	OZ.		

Vanilla few drops See directions for Cocoa Junket

#### Wales & Court . . . 1

Daked Custard			
Milk sugar	40 grams	160 calori	69
Milk	6 oz (180 cc.)	120 '	
Egg	1	80 "	
Nutmeg or			
vanilly			
Sale	a amount		

a speck

Best the egg slightly warm the sugar and milk stirring constantly, add to the eng strain into a custard cup and flavor. Bake in a pan of water in a moderate oven until a kmife when cut into it, will come out ck in (1/ to 1 hour)

# Proof Dudden

bread Pudding			
Wilk sugar	45 grams	180	calories
Milk	f oz (180 cc)	120	ſ
$E_{g_m}$	1 `	80	"
Bread	1 shee 3%		
	thick 20 grams	60	**
Butter	14 or (15 orams)	120	

Spread the bread with butter, and cut into squares Beat the egg slightly, heat the milk and sugar, stirring constantly, mix with the con and pour over the bread Grate nutmer over the top and hake the same as custard

# Translle Tee Choom

Cream	4 oz (120 ec)	240 calories
Milk	2 oz (60 cc)	40 "
Milk sugar	60 grams	240 "
Vanilla	few drops	

Mix the cream, milk, and sugar and heat, stirring constantly, until the sugar is dissolved Then flivor, cool, and freeze

# Cocoa with Milk

Cocoa	1 rounding teaspoonful	50	calories
Milk sugar	60 grams	240	u
Milk	4 oz (120 cc)	80	и
Cream	2 oz (60 cc)	120	u

Mry the sugar and cocoa, cook in the milk until dissolved. Serve with the cream

#### Cocos Conne

Cocoa	1 heaping teaspoonful	50	calories	
Milk sugar	60 grams	240	"	
Water	1/2 cup, 4 oz			
Cream	3 oz (90 cc)	180	"	

Mix the cocos and sugar, add the water, and boil for four or five min utes. Then add the cream, or use less and serve with whipped cream

#### Coffee

Milk sugar	60 grams	200 calories
Strong coffee Cream	45 oz 2 oz (60 c.c)	120 "

Milk sugar may be used likewise to sweeten tea which may be served with or without cream

Lemonade Milk sugar Cold water	120 grams 7 oz (210 c c)	480 calories
Lemon juice	2 tablespoonfuls (or to taste)	

Boil the sugar and water two minutes Add lemon juice to taste, strain, and cool. The white of an egg may be added if desired

Orangeade

Juice of 1 2 oranges 100 200 calories Milk sugar, 50 100 grams 200-400 "

Mix the orange juice and sugar and serve in a glass with cracked ice

#### PROPRIETARY FOODS

A great variety of proprietury foods are manufactured Practically all of them are made from common articles of diet, such as meat, eggs

milk crain, etc.

Proprietary foods possess no special nutritive virtues, as is so often claimed which are not possessed by the natural foods from which they are manufactured. Neither do they possess any medicinent value unless some drug has been added to them. Some proprietary foods are partially digested. The predigested protein foods have an unusuri and often dis agreeable taste, and for this reison tull to stimulate the "appetite juice" libere is no cyclence that predigested protein foods are more completely absorbed than natural foods. In fact, they are likely to cause digestive disturbances and disturbances to long ago pointed out. Some of them contain alcohol, as much as \$2 per cent. If such a food is given as the sole or principal article of dict, the patient is likely to be kept in a state of constant exhaltarition or intorication.

Carbohydrate proprietary foods are said to have been predigested when a portion or all of the struch has been converted into sugar (or sugars). They are neither more castly digested nor more completely absibed than the sugar (or sugars) into which the struch has been changed The proprietry carbohydrate foods in Leneral posses greater mutritive

value than the protein foods

As Ius, has eard the chief value of proprietry foods hes in their tiste—and thus is not always pleasing. Some proprietary foods may be useful at times in order to gratify a patient's desire for change of flavor. Some are useful for modifying other foods e pecually milk. Few, if any, of them should ever constitute the sole article of diet, except for the braciest periods or under exceptional circumstances. On account of their peculiar taste or becaue of the lack of adaptition of the digestine glands (of Parlor), it is always difficult to give proprietary foods in sufficient quantity to meet the energy requirements of the body without causing disturbinces of digestion. Another, and more impor-

tant, fact is that the deficience of virtumius in proprietary foods has been observed to produce serious disorders of metibolism, especially inchildren

The composition of various proprietary foods is given in the following tables

# ANALYSES OF SOLID MEST EXTRICTS *

N m	P C t Moi tu e	Per C nt T i l Ash	C t Chlo in St S d m Chl id i Ash	Pe C t T t i I s t	Pe C t T tal
Armour's Extract of Beef	21 66	20 46	5 47	21 01	80,
Beef Extract Swift & Co	20 16	27 28	13 51	1.38	1070
Beef Extract Com Special G II Ham mond Co Extract of Beef Premier Libby McVeill	12 39	31 68	13 2.	1. 01	13 14
& Libby	21 80	30 92	18 32	14 93	9 99
Liebig's Extract of Meat	21 14	21 03	3 11	30 50	1197
Rev' Brand Beef Extract Cudahy Pack ing Co	94 50	24 06	8 54	29 12	11 11

U S Dept of Agriculture B reau f Ch mi t y Bull No 114 t The sum of insuluble and consulable prot insulvation of any pertones

# ANALYSES OF FLUID MEAT EXTRACTS*

Name	P Ce t Mo s	P C nt Total Ash	C t Chi a m Chi d in Ash	P C t Tot I Pro te at	Pe Cet Ttl M ; B e
Beef Juice Wyeth & Bro	58 84	10 21	671	645	5 99
Concentrated Fluid Extract of Beef		ŀ	l		
Armour & Co	5770	17 93	8 27	676	5 18
Fluid Beef Jelly Mosquera July Food Co	69 97	13 95	10 Ou	81.	3 06
Fluid Extract of Beef Cibils Co				1	
Importers	64 63	16 13	11 39	10 95	4 04
Meat Juice Valentines Meat Jui e Co	57 64	10 26	177	5 63	G 0.
Rex Fluid Beef Extract Cudahy Pack			i i		
ing Co	5.93	16 99	848	7 00	8 91
Vigoral Armour & Co	49 94	15 91	7 02	10 75	6 30

U S Dept of Agricultu e Bu au f Chenity Rull > 114 †The sum of 1 luble and coagulable protei p t e and p pto

There are various other meat extracts on the market but the average analyses of the different brands are so nearly alike that the various constituents will not differ markedly from the above figures

MISCELLANEOUS I REPARATIONS (MEAT EXTRACTS JAICES AND POWDERS)*

Nam	P C L W L	P Ceat Ttl Ab	Per C t Chl n 5 d m thl rid A h	P C t T t l P te t	Pe C nt T t i Meat B
Bouillon Capsules Royal Specialty Co	1470	39 75	29 72	22 19	6 93
Boyril seasoned	43 39	10 09	8 73	27 06	6 03
Beef Jelly Mosquera Julia Food Co	7 99	17 31	8 39	25 63	924
Essence of Beef Prand & Co	90 93	134	0.09	07 ن	1 ∪4
Predigested Becf II h Mulford Co	91 69	0 18	0 01	1 19	0 69
Soluble Beef Armour & Co	301.	14 .5	5 91	3 ты	6 65
Boyox Fssence of Beef The Boyox Co	6.17	17 23	973	"د 16	2 18
Johnson s Fluid Beef	41 /2	9 80	4 07	31 75	3 87
American Brand Extract of Beef Ameri can Beef Extract Co Bovinine Concentrated Beef The Bovinine		o4 73	24 73	2r 69	3 59
Co	80 40	1 55	1 05	14 14	0.09
Fasence of Mutton The London Essence Co	8,03	20,	0 18	12 00	178
Liquid Fool Murduck Liquid Food Co	86 09	0 65	0.0	10 69	0 25
Maggi s Bouillon	56 5F	91 94	175	2 13	5 93
Peptonized Beef Ro e	45 13	3 52	1 63	22 00	9 89
Beef Fitract and Vegetable Tablet Armour & Co	97.29	23 6F	18 14	18 67	815
Leube Rosenthal Beef Soluts n	7268	3 91	1 94	16 13	134
Malted Mest Extract of Beef American			Ι.		
Malted Ment Co	8 61	7 87	3 49	9.82	1 40
U S Dept f Asticult B rea f Ch a	lts B	tt No 1	14 1909		

The s m flool bl f co gui bl p tla, p tenses and p pt bes

The following table giving the composition of meet juices prepared in the laboratory, illustrates the nutritive value of home-made as compared with commercial products. Bigelow and Cook ¹⁹ state that meet juices prepared in the home or hospital is far superior as a food to the commercial meet extracts and so-called meet juices.

MEAT JLICES PREPARED IN LABSRATORY *

N on	P C t W t	Per C t A h	P Cent Chl d Chl d	Pr Cent 1 1 bl Pr 1 s	Per C t C ru l bl P
Round beef coll pressed	45 "6	1 53	0.19	1 00	8 56
Round beef pres ed at 60 C	90 Ca	136	0 15	4 9	5
Juice extracted from sirloin steak by cold pre sure Juice extracted from beef chuck by cold	96 13	0.46	000	2 1	3
pressure after 6 hours at 60-160 C	99 11	0.0	0 ಗಿಸ		

C 5 Dept of Agri R re B rec f Ch mit y B II No 114 1904

[&]quot;U & D pt. of Agricultur B reau f Cl mi try Bull No 114 1908

tant, fact is that the deficiency of vitamins in proprietary feeds has been observed to produce serious disorders of metabolism, especially in children

The composition of various proprietary foods is given in the following tables

#### ANALYSIS OF SOLID MEAT EXTRACTS*

Nam	Pe Ce t M tu	Per Ce t T t l	Per Cet Chin 8 dum (b) d i A h	Pe Cent T tal P	Per Ce t T t l Me t B s
Armour s Extract of Becf	21 66	20 46	5 47	27 01	80,
Beef Extract Swift & Co	20 16	27 28	13 51	15 38	10:0
Beef Extract Conn Special G H Ham mond Co Extract of Beef Premier Libby McNeill	12 33	31 68	13 2.	1.01	13 14
& Libby	21 86	30 92	18 82	14 9.	9 98
Liebig a Extract of Meat	21 14	21 03	3 11	30 50	1197
Rex' Brand Beef Extract Cudahy Packing Co	26 50	24 06	8 54	29 12	11 11

U S Dept of Agricultur Bureau of Chemietry Bull No. 114 † The sum of insoluble a d coogulable proteins p ot o es and pepto es

# ANALYSES OF FLUID MEAT EXTRACTS*

N me	P C t M tu e	Pr Cent Tot ? A h	Cet Chi n bd m Chi d i A h	P C nt T tol Pr te s f	Pr Ct Ttl Met B
Beef Juice Wyeth & Bro	58 84	16 21	6 71	C 45	5 99
Concentrated Fluid Extract of Beef Armour & Co Fluid Beef Jelly Mosquera Julia Food Co	57 To 69 97	17 2s 1s 85	8 97 10 05	676 913	518 306
Fluid Extract of Beef Cibils Co		ĺ	J :		
Importers	61 63	16 1°	11 39	10 25	4 24
Meat Juice Valentine's Meat Juice Co	57 61	1026	177	J 63	600
Rev" Fluid Beef Extract Cudaby Pack- ing Co	5. 99	16 99	849	700	8 21
Vigoral Armour & Co	49 94	15 91	707	10 75	6 30

U S Dept of Agricultur B a of Ch mi ty Bull No 114 the sum of incol bic a d congulable p t in proteose and pepto es

There are various other meat extracts on the mirket but the average analyses of the different brands are so nearly alike that the various constituents will not differ markedly from the above figures

		13.60		65.43	97.17	960	Not so rich in minerals as claimed to be
Frame Food				46 09	370 46 09 30 56	1 42	142 Much cane sugar
Franco-Dwi s Food	308	10.15	8	67.95	8	3 46	Holt oth ed 1909 Desicented milk 000
Hornck 8 Multed Milk	9		90	. 38		670	whent flour 2625 barley mait 230
(ready for use) Carticulum		_		_			odium bicarbonate 075
ver 1 to Martin Land	19.	12.04	1 40	41 97	000	09 0	o 60 J D Hender on
Harlick a Malfed Fuel	0.0		0.0			182	182 Fully malted
Horis Dables Food	2 2		0.10		90.10	1.70	Starch 75 per cent
Toront Grantin	1	10 91	190	5,3	5"3 1,0 72	8	
T and I Ford		1030	9 30	8	•	1 40	
John Bull As 1 bood	333	90 1	11 87	4 09		32	
Tabe Tall As a bond	1.68	11 06	0 63	3, 65	43.50	7	Malto e "331 dextro c 13º dextrin
Court of the court							J. Nactore 7.65
Line han Indian Board	4 37	13.05	1 69	03 71	03 71 30 46	5 03	Made in Germany
Tabelen a Leading Mail	41.50		24 60	Ŧ	4180	1 50	Made from nuts and can be added to milk
Lochards (ream Emulion	6 3		1,32	49 43		00 0	A thick brown na te made from milk and
							malted wheat extract
Maltico Fool	92.0	92 36 07	11 40	3	69 59	3 83	Lancet analysis
	13	1 19	17 19	2	8	ç	malted cereal no starch
Manhu Infant Fool	8 40	01 8	200	13	72 90	100	Deaccured milk and malted cereals much
Mellin & Food	502	10 35	0.16	0.16 79.54		10 10	-
							It is a descented mult extract from
			_		_		wheat and barley
Wile Fool	3 51	3 51 14 34	5 0	5 0 59 93 15 39	15 39	203	А
	_						27 36 and enne sugar 9, per cent
Moseley & Foot	1084	10 84 14 78		21 76	184 2176 4906	23	1"2 Complete conversion during mixing
Most fib lyse treeps why oth rwise tid	oth rale	=	ė	-	the gie by thmk a	:	

a will not do a 15 and in the little of the letter of the

Carbohydrates said to be made soluble in

preparation

122

130 3.0

82 40 00 1 19 8 40

830 3 4 8

Dry Peptonoids soluble Fairchild's Milk Powder Falona

Cercals and a fat containing bean Practically milk sugar

ANALYSES OF LAFANTS AND INVALORS FOODS*

From	Sutherlar	d's Sys	tem of I	Dret and	I Dietet	tes (sltg	From Sutherland's System of Dret and Duteties (slightly modified)
	å	3		Carbok	Carbohyd ter		
Name of Food	ing t	P Ceat		Per Cent Sol bi	40 8 25	## 40¥	Remarks
Albany Food	8 60	000	9.10	1.3	15: 8	0 40	Much unchanged starch
Allenbury Food \o 1	1 82	10 70	16.79	6.51	1 10	4 03	
	5.70	0.20	14 00	668		5.	
	83 30	156	230	7 20		090	Ready for use Hutchigan
Allenbury Food No 2	61	10 23	1434	67.74	1 24	_	Anglese by Processing A marked man
	330	320	12 30	72.10		3.0	whe No 1 Food
Allenbury Food No 3	300	1033	100	20.21	62 91	090	Analysis by Freedmin Donth males
	3	9.0	100	88	-ï.	9.0	44.03
Andreas Swiss Food	2 68	10 54	281	4,3		121	Much cane sugar
Doo'l selwe organ	9	1620	16	46 43	87 G	202	Theh cane sugar
Dananing Person President	9	410	0 0	86	8100	505	A banana flour
Doo J & Laguar	2.2.2	1218	160	39	337   1630	060	A milk modifier Much digested in pre
Cararrele a Soluble Food					!		paring
Chanman Whole Thous		30 00	900	28 11	52		Much unchanged starch
Chelting Infants Food	P 6	05.6	3	-	33		A whole meal flour
Chelture Malters Total	202	16.20	3 92	F	71 00	183	Contains much starch
Combs Malted Food	3 3	8	0.27	87 60		2 25	Fully malted
Cremalts	200	1,10	280	2	20 50	0.40	Much unaltered starch
Diastased Farms	9.23	9 20	20.56	Ŧ	44 67	1.79	
	9	3	96.1	<b>≅</b>	8170	1 10	Carbohydrates said to be made soluble in

starch

8

-

ŧ

1035

8 63

38 0 16

Vanhu Infant Fool

Welling Food Wile Fool

Analysis by makers For modifying milk

7-16	1 260	1369	0.44	33	1 36 7	960	-60 13 69 0 041 1.0 33 ( 34 96 ) 0 96   Not so rich in minerals as claimed to be
Frame Food	7	13 00	370	46 09	30 56	7	Much cane sugar
Transcovers a coor	0	16 35	8 79	67.95	900	3 80	Hole 5th ed 1903 Desicerted milk 200
HOTHER S MARKEL MARK	07.00	02.10 1.15	090	33	_	6.0	wheat flour 96 % barley mait 23 9
(really lor use) childranen							sodium ticarbonate 075
ve. b.d. Willed Poul		19.06	1.40	41.97	000	5 60	J D Henderson
Hornes and Ford	3,0	1.70	0.0	0.0 90 00		182	50 152 Fully marked
Trees to the	2.40	0 2	010	8	2	1 70	Starch 7.0 per cent
Terrorial Carmina	2	10.01	0.03	5	20.01		
I and I keed	200	1030	930	8			Mainly starch
The Part 100	80.60	21 00	1	11 h. 14 93			32 Maltore 21 12 Jacto e 734 de trin 3 5
John Bull Ac . Fool	1 68	11 06		30 78	3, 65 43 30	174	Maltoce 9331 dextro e 137 dextrin
100 100 1000							. 38 Ireta o , 65
Rucken Infant People	834	13 91	163	73.1	50 70	2,3	83, 13 of 163 3 11 30 76 2 3 Male in Germany
Lympan a Located to Mile	24 40	2.0	3	=	9	0	Made from nuts and can be added to milk
Lordund Cream Francisco	3	5	1,32	CF GF		3	A thick brown na to made from milk and
	_						multed wheat outract
Maltico Food	930	10	1180		67.40	3 89	3.54 Linect analysi Composed of milk and
	=	10 19	111		6300	2 3 3	matted cereals no starch
Manhu Infant Fool	480	9.70	480 470 560		05.7	3	Desicented milk on I malted cereal raugh

. . . .

It is a descented malt extract from De secated malk with multoso ard dextrans 36 and cane sugar 95 per cent Complete conversion luring mixing wheat and larley 173 33 by the m k 15 39 49 06 9 93 21 76 o the give 5.0 184 1434 14 78 except where otherwise 1 t d 10 44 3 31 1700 .

Mostley a Lood

Vost f th

ANALISES OF INFANTS AND INVALIDS FOODS (Continued)

	,			Carbohyd tes	tes	,		3
Vame of P d	Cent W te	E P	32	Sel bi	43,	 \$34	Ren rks	
8 Food	476	15 19	5 10	15	72 42	2 43	Angles by Stiffer and Bichmond Deng	
	563	1434	980	27 41 1 44 43	44 43	7.39	cated malk powdered whate of ega-	
Neaves Food	5 03	12 90	1,70	F	10.00	8	wheat flour and lactose	N
N. stle a Food	5	11.11				3 6	tractically all starch	U:
Nichols Food of Health	11 90	7.70	200	92	76 90	3 5	A milk modifice Manny starch	TR
Nutron Food	680	1,90	1030	99	66 00	1 00	Cereals alwa nonnet flour honce the fat	17
Opmus Food	1030	9 20	90 7	_	28 60	040	A translated wheat flour	1
Description	200	12 01	1 33	16 70	61	3 ‡	A Swiss product	O
rhosphathe raineres	Š	23	193	56 68	31 98	1 23	Calcium pho phate cane sugar and starch	
Ridge s Food	9 23	9 24	0 63	5 19	27.96	050	of potato rice arrow root sago cocoa	AN
Robinson s Oronts	1040	11 30	1 60	,	22 00	1.76	Manny staren	D
L'obinson & Patent Barley	1010	513	260	411	77 76	1 93	Ground nearl healow	D
Savory & Moores Food	534	1079	3	27 81	54 09	0 91	When four party male much	
Sport a Oat Warm	834	9 63	0.40	44 83	36 96		Cane surer	T
Thenhart Triange	200	9.10	2 00		78 20	130	A fine oat flour Cf Greats	E
dill.	900	16 17	90	13 61	16 72	3 47	Desiccated milk diastased cereals lacto e	r I (
Themhart's Hygnama	4.75	21 22	10 0	49 10	11 33	3,55	and cane sugar	CS
Tritcumina Food	03.8	40,0	00 0	— <u>;</u>	- 5		The fat is partly cocoa butter	
Virol	11 66	6.43	19 72	9 19	2 -	30	Mainly starch	
Wells & Richardson s Food	24 04	4 16	1075	202	96 49	180		
	:		1	3	62.00	d n	Fartly malted Contains much cane sugar	
Wheat Flour	9 03	7.47	101	5 66	76 07		and no muk	

Wheat Flour baked Worths Perfect Food	2.40	11 10		200 8350	۶ ع ع	020	
				BUGAR	24		
Aylestury Dairy Co a Humanized	49 43	130	4 00	-	4 70	0 49	
Aylesbury Daury Co & Humanized		-	-				
Milks to 2	8830	020	200	-	8	50	
Tagger refrected will rood	5	0	000	-,		0.00	
Coerners Lettenich		5 9	2 6	-	222	2 2 2	
Sweetned williams	9.4 04	98	3 2 2		3 8	2 5	
Condensed Shim Milk	20 03	10 73	0.63	. 3	3	263	
Wells Richardson and Co Lactated					_		
Food	6.0	9 6	0.43	29 65	5134	101	
Charles Martin s Cardinal I ood	913	10 50	0 35	8	71,6	9,0	
L kny s All umenized Food	-	7 05	4.5	36.	24 90	0	1 milk modifier
Incto-Cktulin	9 95	7,4	0.5	11 65		9,30	
Wampoles Milk Lood	33,	14 18	7 10	130		3 64	
Wemaits	3°	10 31	2	20 68		0.78	
Triangle Food	73	12 23	1 70	3 75	7.	0,0	
Fuglish Milk Food malted	5	8 33	0,0	3030	39	060	
Christie a Food	3 70	0	305	35 65	010	9	
Wyeth & Prepared Food	3 00	1469	1 30	63 30	25	3.0	
Balva Own	9.50	963	0.	06 60	233	0.53	Requires additions of varying amounts of
				_			mit.

CARLE OF SO CALLED MEDICINAL FOODS

		TABLE	00 40	TE GITI	AABLE OF DO CALLED AIRDICIAAL FOODS "	sdoo				
	Gly a		Prce 1	Carbohyd afe	yd afe	¥	Al ob i	Ave age		186D
po d	date to	ų ų	Natt (Vx6 5,	B to b	Jave on	Nol m	We git	Ad RD 4	Fr non	to S pply 1 430 C lor e
Carpanutrine	o∓ 82	0 93	£ 58	4 22	12.0	15.5	12,	Ę	180	\$3.39
Laguid peptones	363	100	40	990	600	220	180	1.0	978	78
Liquid peptonoids	0.53	0 33	4 93	999	10.51	17.5	140	150	247	90 6
Liedigested beef	340	0 18	238	4 29	4 37	19.7	160	100	212.0	6.
Nutrient wine of beef peptone	1497	0.23	790	11 67	15 43	21 5	17.	100	178	2.5
Nutritive liquid peptone	1 02	0.84	186	12 58	12 89	23.0	188	150	5391	7.
Panopeptone	2 60	1 10	638	2 20	11 92	19.5	150	5	66	68.6
repronie chan	321		3	11 40	11 46	188	165	90	1.73	- E
Tonic beri S & D	13 91	191	3 40	1 #8	226	349	150	0,	0	6
Committee of the commit	0.44	0.87	181	0.55	0.55	140	130	8	2	1 10
co v s mink () 7 per cent rat)	_	0 0 0 1	3 20	4 50	9 <del>1</del>			2 000	1 429 6	0.50
I am I de the description of			1			1				

I up I the Ame M d I A o t m at 1 1612 1967 Trotal chiefts per cleam dose lactuck at the extent's of alrebed in the Unguid medicional foods and the calories of the fat in milk

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#### CHAPTER III

## PRINCIPLES OF TOXICOLOGY

# FRANK P UNDERHILL

Toxicology —Toxicolo, I is the science of poisons. In its broader use it is the science that treats of the origin, nature, properties, effects and detection of poisons, and it includes treatment of poisoning. The science falls naturally into two divisions. (1) that dealing with the effects of poisons, (2) that relating to the chemical identification and solution of poisons. From these divisions it is readily seen that the first relates more especially to physiological action, whereas the latter is primarily concerned with chemical reactions.

To give a general satisfactory definition of a poison is a somewhat difficult feat. Nevertheless various attempts have been made, examples of which follow

Husemann "We define poisons as such morganio or organic substances as are in part capablo of artificial preparation, in part existing reads formed, in the animal or regetable kingdom, which, without king ible to reproduce themselves through the elemical nature of their mole cules under certain conditions, change in the healthy organism the form and general relationship of the organic parts, and through annihilation of organs, or destruction of their functions, injure health, or, inder certain conditions, destroy life."

Lobert "Poisons are organic or morganic unorganized substances originating in the organism itself, or introduced into the organism, either artificially prepared, or reads formed in nature, which through their chemical properties, under certain conditions, so influence the organs of living beings that the health of these beings is seriously influenced temporarily or permanently.

Blvth "A substance may be called a poison of it is capable of being taken into any living organism, and causes by its own inherent chemical nature, impairment or destruction of function."

# CONDITIONS MODIFYING EFFECTS OF POISONS 105

Sollmann "A poison is any substance which, acting directly through its inherent chemic properties and by its ordinary action is capable of destroying life or of seriously endangering health, when it is applied to the body, externally, or in moderate doses (to 40 gm.) internally

#### CLASSIFICATION OF POISONS

There are at least two ways in which poisons may be classified (1) according to their chemical properties (2) according to their phisological effects. From a scientific reversion in cultiver system nor a combination is entirely adequate and one must either omit all attempts at classification or else be content to classify por one from the standpoint of practical utility only. A chemical classification follows

1 Acids and alkalis

4 Alkaloids

2 Metallic poisons 3 Gaseous poisons

- 5 Volatile organic poisons 6 Miscellaneous poisons
- The physiological classification recognizes the most prominent symptoms as the basis for division of poison. According to this classification, which is that adopted and defined by Sollmann poisons may be divided

which is that adopted and defined by Sollmann poisons may be divided into three great groups

1 Irritants—These produce inflammation, if they are taken by the mouth, there is pain throughout the alumentary canal, somiting purging

- mouth, there is pain throughout the alumentary canal, comiting purging delirium, coma. So meny poisons are to some extent irritant that these symptoms are very commonly present. The irritants can be divided into corrorners which produce destruction of tissue and simple irritants which do not de troy tissue. If corrosnes are taken by the stomach the vomit is often bloody.
- 2 Nerve Poisons—These act on the neuroniuscular apparatus and include most of the poisons which are fatal in minute doses. They are ambitived into considerate which cause apisons sommifactents which cause aloop and coma, and carduae poisons which stop the heart.
- 3 Blood Poisons—These poi ons after the hemo-lobin or blood corpusedes. These include the toxic gases intrites, etc. Their action is generally characterized by exanosis.

#### CONDITIONS MODIFYING EFFECTS OF POISONS

The influence of a poison upon the organism is very naterially modified by a variety of conditions. In general these may be divided into two great classes (1) those relating to the poison itself and the manner of its administration, (2) those relating to the organism itself.

# POISON AND METHODS OF ADMINISTRATION

Physical State or Form of a Poison—The physical state of a poison has a marked influence in modifying its action. Thus a poison in modifying its action. Thus a poison is more rapidly absorbed in a gaseous form than in a solid or even a liquid state. In order that a substance may act as a poison it must be capable of solution, and absorption by the blood. No substance completely insoluble can be regarded as a true poison. Barium chlorid, which is readily soluble, must be regarded as a extremely toxic, whereas the insoluble harror sulphate is devoid of toxic properties. In fact advantage is taken of this in the employment of barium sulphate in X-ray photography in diagnosis of gastro mitestinal disorders. The principle of the form of poison modifying its action is made use of in the treatment of various types of intoxication by means of antidotes, the object aimed at being to change the soluble substance to one insoluble and better energable of absorption.

In general, dilution of a poison tends to favor rapid absorption and this in turn hastens and intensifies the toric effect. An exception to this rule is seen in the case of those poisons with a corrosite action. These have their detrimental influence greatly decreased by dilution. Poisons taken into the stomach in the form of a dry powder may not manifest four symptoms for hours after administration. Usually the larger the dose the more rapid and severe are the effects. This, however, is not always true. This arsenie in large doses may act as an irritant to the stomach, causing vomiting, with prompt ejection of the poison so that few or no torus symptoms result. On the other hand a very much smaller doe, being devoid irritant action on the stomach, allows absorption of the poison with subsequent symptoms which may terminate fatally. Again the solvent containing, the poison exerts a marked effect upon its action. Thus of alcoholic, aqueous or oily solutions, the first is most rapidly absorbed, the last least so and, in consequence, more prompt and emphatic effects are to be expected the more rapid than old.

Path of Absorption—In general a poison everts its specific action irrespective of the mode of administration. In other words, it makes that difference through which pith the poison reaches the circulation. The only modifying unfinence everted by changing the path of absorption is the time of appearance of symptoms which varies directly with the rate of absorption. This symptoms appear most rapidly when poisons are in jected directly into the blood-stream. Intraperitoneal and intramuscular injection is tind next in order followed by subcutaneous and intradermal injection.

Poisons are less rapidly absorbed when taken by mouth The condi

tion of the stomach greatly modifies the rate of absorption A di cased stomach mix markedly delay the absorption of a porson or, on the other hand, prove highly susceptible to an irritant poison. Food in the stomach may delay absorption either by retarding the emptying of this organ or by changing temporarily the physical state of the poison. Many apparent anomalies of the effects of poisons may be explained in this manner. Although it may be generally accepted that the path of absorption modifies the action of a poison only in its time relations and does not after its specific effect yet there are notable exceptions for in certain instances the mode of administration materially alters the action of the poison. This is particularly time of substances resembling proteins, hence capable of alteration by the digestive curkings. Stake venom by mouth is entirely harmless even though highly possiones when it gains direct entrance to the blood. The same is true of the torse proteins, recin and abrin, and various before it towns fall into the same class.

# POISON AND ITS RELATION TO THE OPPONISM

The most important conditions residing in the organism that modify the action of poisons are (1) age (2) idosynerasy (3) habit (4) tolerance, (5) physical state of the individual

Age—As might be assumed, the age of an individual distinctly modihas assecptibility to por on. Although as a rule, the younger the individual the greater the since pitbility there are many notable exceptions. Thus, for example, children are relatively less susceptible to the action of strichini bell'adonia, and calomel. Conversely young children are particularly susceptible to the action of opinim and its constituents and the same may be said of the other narrotic drugs. In old age possons may react with numeal sevents undesting a reduced resistance.

Idiosyncrasy—The term idiosyncras is applied when an individual relations to certain possible peculiar unusual relations to certain possible for this peculiar personal assecptibility or tolerance may result in serious disturbinees in bothly function or even terminate in death. In a given case of possion, the possibility of this distinctive characteristic should always be taken into consideration. Idiosyncrasy may be main fested toward a large number of substituces wow of which are ordinarily non-toxic so that this numeral sensitivities may be both qualitative and quantitative. Thus festure is broughly into prominence, in different in dividuals aspecially by morphin calonael, argenie, mercury antipyrin cooni etc.

On the other hand in some individuals a drug will induce an effect exactly opposite to that usually produced. Thus morphin will cause wakefulness instead of sleep or in larger does convulsions simulating those

of strychnin Many individuals react with severe symptoms after eating or smelling of a large variety of sub-tances, such as lobsters and other shellfish, hones, various fish, eggs, mutton, strawberries, sewer gas, mit l, smell of animal, and odor of flowers.

Habit—Repeated mall do es of a poron generally les en the effect By gradually uncreasing the initial small does of a poron relatively large does may be taken without evidence of toxic symptoms. Habital morphin isers are pertuent examples, yern large does being neces are finally to produce the desired effect. Again in certain parts of Europe areane enting is notoriou, large quantities being taken duily. Whether in the case of morphin the organism develops an ability to oxidize the drag to an immisual degree or whether the init time neglines a resistance to absorption remains indecisive at present. So far as areane is concerned the a simption has been made for main veris that there was a gradually increasing resistance to its effects. Veri recently, however, it has been shown that the apparent habitatation to areane may perhaps, in part at least to ascribed to the quality of the arsence con much. Thus when arsenin made up of small cristally, or powdered, was ingeted, much maller do es were needed to produce toxic effects than when larger particles were introduced. From this it would appear that the whole matter may be explained on the basis of solubility of the arsence, the powder or small cristal being made more readily soluble, hence more rapidly absorbed, than the larger, covere, crystal

sorbed, from the larger, correct, crystal

This tolerance to possous acquired through habit is not absolute, since
generally toxic effects and even death may be induced by slightly exceed
ing the limit of habituation. It is this fact that largely explains the
death of the habitue of morphin and of other similir potons. Habit,
however, cannot be acquired with all drugs, for antimony or mercury, for
example, cannot be taken long with impunity even in relatively small
does

Tolerance — Certain individuals exhibit a very noteworthy resistance to the action of certain possons. This resistance or tolerance is natural not having been acquired by histination but it is rank a shoulte of that it can hardly be regarded as a natural immunity. Thus some persons are capable of taking large doses of morphin without any apparent effect. The explination of this peculiarity is not clear. In some instances it may be due either to non ab orption, rapid climination, innisial ability to neutralize or destroy the poi on or to anatomic peculiarities. In ome instances none of these hypotheses seems to hold

Disease—Pathological conditions in the body may very naturally influence the action and effects of porsons. This modified action may be munifieded as an increased susceptibility of the effect may be greatly diminished. Those conditions that influence absorption and excretion play a particular role in this respect. Renal disease, for example, increases

the susceptibility to are mic and other druce. In paralwill, strychmin acts less readily. In peritoint debrium tremens and in those states where inters, pain cut it, the power of morphin i diminished whereas in conditions primarily a sociated with the nervous system, as in inflammatory conditions of the brain an increase sus-epithility may be noted. In in anity with manifest characteristics and in courul tons, narrottee may be almost without influence. Exhaustion tend to increase susceptibility General reduction of vitality from whatever cause it. unliv means a lowered functional activity has a tendency to diminish or at least to re and the action of posions. On the other hand, leep perhaps owing to less-ened functional activity has a tendency to diminish or at least to re and the action of posions.

#### FATE OF POISONS

After absorption poisons rapidle leave the blood nulles indiced they combine with the constituents of the blood and change its characteristics either temporarily or permanently. In general bowever, poisons remain in the blood for a comperatively bort time being excreted through the units shirs hile sweet and feecs. In certain intances more of the poison is eliminated by the feecs than by the units lead, for example Leadily, lowerer most of the poison as-to be way of the real path. The ones are promptly eliminated from the loads but are deposited in all the principal organs and it use. In general the livre contain, the greater amount of stored poison, the amount deposited in the other organs varying with the type of poison. Gazeous poisons are not deposited but are promptly descreted by the long-

So far as one may judge a posson deposited in an organ enters into some chemical condustation with the cellular constituents and while this deposited may be regarded as without postal distinuously effect. Gradually this combination di rupts and the posson is thrown into the period circulation, injuring sensitive tixnes in its passage to the exercisor organs which indeed, may suffer injury sufficient to cause death. I sually morganic pusors are eliminated from the body unchanged the organic meaning unable to alter them. On the other hand, the natural response of the body is to change or modify the posson prior to elimination. Most of the organic possons are altered in passage through the body by combination with constitution of the body or by undergoing condution hardless as or defer similar transformation.

# SYMPTOMATOLOGY OF POISONS

There are certain out tanding features in possening that may be of value to the physician in diagnost. These symptoms are general and although they do not indicate specific poisons their presence or absence

excludes certain possibilities Special symptoms relating to specific poisons will be considered under individual poisons

Nausea, Vomiting and Purging—When these suddenly appear in a normal individual, it is indicative of the presence of a gastro-intestinal irritant or of the onset of some acute disease. Many poisons, especially metals and food poisons, are characterized by initial symptoms of nau ca, comiting and purging. If the history of the case agrees with the possibility of poisoning, measures should be taken at once to assist the body in its efforts to rid itself of the notyons substances.

Vasomotor Disturbances—The effects of porsons upon the vasomotor centers is indicated by the fact that many poisons lead to marked changes in the skin. The color may be pale or the natural color may be much in tensified and urticarial rashes are common. Heart action and respiration may be markedly modified in either direction.

Cerebral Symptoms —The influence of poisons upon the cerebrum lead to stupor or coma or may produce convulsions, illusions or hallucina tions. Thus, hallucinations and temporary delisions may follow the use of salicylic acid and strychini may cause convulsions. Stupor and coma may be induced by narcotics or may be due to alcoholism or cerebral hemorrhage.

Temperature — The temperature changes in poisoning have not been sufficiently studied to make definite tatements concerning them. Certain it is that usually changes in temperature must be regarded as secondary effects rather than specific effects of poison. Some poisons, like cocon in large doses, may elevate temperature, but usually in poi oning the temperature is either normal or is low, in some instances being as low as 9.5° F.

Fulse—Generally in tente poisoning the pilse is quick and feeble, the extent to which this is true being determined by the degree of shock that may be present. Poisons that have a specific action upon the respiratory center may influence the pulse only slightly, if at all, and the pulse may continue with a good tone for some time after respiration has censed

Respiration —The most common effect of poisons on the respiration manifests itself in dyspner, which may be due to mechanical obstruction, as in dema of the glottis from local action of a corrosive poi on, or to paralysis, as in chronic lead porsoning, or to muscular spasm, as in poison ing with strychnin, or to direct action on the respiratory center, as may be observed with some poisons of hacterial origin. Cheyne-Stokes respiration marks the approaching termination of many cases of fatal poisoning Motor Disturbances—Motor disturbrines are so characteristic in

Motor Disturbances—Motor disturbences are so characteristic in certain instances that they lead at once to a correct diagnosis. In lead poisoning the wrist-drop is sufficient to arouse suspicion tetanus due to strychnin poisoning is quite peculiar and the mydriasis of atropin poison ing is characteristic Retention of urme occurs with narrotic poisons, although a general reaction of tatal prisonner is parallely of sphine one. This fact tied it complies a diagnost

The Eye—Only a few many upon the eve are of pair cular railor. This contracts in of the pupil by morphin and dilata ion by atting a are quite characters to 1 fellow it will with surfaint and blind we to all world allowed presenting are quite events.

The Ear -Q than came a ringing and in the ear the bearing is more sente under the unit was a first radium and salt the acid of sea as

bazzing sensa on.

Modified Sensitions—Varia, charge of sensition in the skir. It is as a selection by preparations in passand need to ensure a co. probably have their errors in which from elections as a should farm be example of alternatives of sensition indirect by variation.

Skin Lenons.—The king-ordinated two of he undo or solid if are real in series or funded with the continuous are trapped unit given in a to the predict coloring of the kin salled are recorded to the coloring of the kin salled are recorded to the coloring of the same for a part is respected by for sared kin crup total particular of the sation. It tracerall seafarmed and in the form critical teacher with a large or primary of the kin.

## DIAGNOSIS OF POISONING

At times the diagnosis of p. 4.10... I exceedingly d E al. since with a few intally exception the effect of point a re to the factor of the attention to the able to make a diagnosis

of possering a that proper treatment may be in ituted.

Support of presents, since if an individual who has proposed.

been map purent good health and hade maint's mostal' paths' and emptives which rapidly been in min red. This is processes a affected if the wrap in appear a left time absorpt ettails a recession of weak food or drink which have have had a possible robust or take in it is timber affected. Bed if it wroptions agree of both with the characters to of a communicipal possible and if they can be differentiated for a discuss.

In gueral, the play seam is guided with the sempt main avid rec. This may entirely included him the a startet of disease raw cause vings miss insulating these i directly poisses. This contact poisse includes in middled by ga treat rate, can a sind later and later and the same in the steen appendix it ministrated be rate in principles of the other hand many tree passing may be smallered by principles of the other hand many tree passing may be smallered by principles.

spinal system, inclinia, etc. The symptoms of arreine poisoning and those of cholera morbus are very similar. One may readily mistake apoplers or urenna for opium poisoning. The resemblence between the symptoms of struching poisoning and tetamis is very close.

In acute posoning a careful examination will many times enable the physican to make an immediate accurate diagnosis. I vidences of corrosion on the lips, tongue, mouth and throat lead one to suspect that a corrosive poson has been taken. Chloroform, carbolic acid, potassium examid and other odoriferous substances may be detected on the breath and examination of the comitts and even of the faces may recent important evidence. The urine is of considerable importance in examinations of this land.

The long-continued use of sulphonal or trional gives the urine a red color from the prisonee of hematoporphyrin which may be identified by the spectroscop. Methylenc blue imparts a green color to the urine, and autipyrin and fichsin cause it to assume a red line. In suntonin poisoning the fresh urine is normal in color but upon being made allkaline turns bright red. The urine turns dark green with planol and cressly the color deepening on standing. Quinni may cause hemoglobinitria which also results from the inhaltition of arsenutrated hydrogen. Potassum chlorate induces methemoglobin, and blood in the urine may follow the administration of any genito-urinary irritant such as canthards or turpentine. Phosphorus, increary or lead may give the urine a brown or greenish provincelor.

Chronic poisoning is even more difficult to diagnose than acute poi on ing, because the symptoms are usually not sufficiently definite to arouse

the suspicions of the physician

There are no definite rules to establish a diagnosis of poisoning during life overpt by chemical analysis of some of the exerctions of the body, such as time, feece or vomities. Any drink, food or medicine suspected should be subjected to analysis also. In no other way is it possible absolutely to differentiate between the symptoms caused by disease and those induced by poisons.

### TREATMENT OF POISONING

Each type of poisoning requires specific treatment In many in stances, however, the poison taken is unknown and it is therefore essential that general rules of treatment be established These are (1) removal of the poison, (2) administration of antidotes, (3) symptomatic treatment

Removal of Poison — The measures taken will depend upon the site to which the poison was applied. If the skin or mineous membranes are concerned, the best agent for removal of the poison is water copiously

applied. This application not only dilutes the irritant agent but washes the site free from it. If the poison is not freely soluble in water (for instance, circloid eadly, alcohol may be employed. Chemical antidotes may be added to wash water—thus for acids sorps or liminent calcis for alkalis lemon juice ar vinegar. It abould be pointed out that strong acids or alkalis should never be in ed. in the treatment of irritant poisons. After the site has been thoroughly freed from the toxic agent it should be covered with a bland oil or sixle.

Not possons are taken by mouth hence, in treatment, the storisch should be emptied as soon as possible unless indeed sufficient time has alpased to make this procedure noises. On the other bind, it is always a good plan to follow, since the cleaning of the stomach aids greath in most cares of poisoning. There are only a few instances of poisoning where emptying the alimentary tract is contraindicated. The most notable of these is in strychinn possoning and in extensive corrosion of the alimentary can I in emptying the stomach two types of procedure may be followed the administration of emeties and layage. Limeties are not caulty given and layac the advantage of not causing string-line on the part of the patient. If possible however layage employing the stomach tube, either through the mouth or nose is to be preferred since it cleans at the stomach more throughly and also permits the introduction of cleanical antidotes. Moreover, it is less depressing to the patient and must be employed when possions have been taken that inhibit the vomiting center—for example chloral or morphin.

If emeties are administered repetition should be practiced at intervals of from 10 to 30 minutes if meassart appropriate (a mg [grain 1/10] in 1 per cent solution = cc) subentaneously is very rapid and effective in its action but has a di fincili depres in influence. Its great advantage lies in the fact that it is the only emetic that can be given hypotermically and it is particularly in eful when resistance to treatment is offered Copper sulphate or zine sulphate are safe and efficient emetics Copper sulphate is perhaps more effective than zine sulphate but it is also more trritant Both product a nummum of depression. They should not be employed when irritant poisoning is under the itment. The dose of zine sulphate is 2 grams in a glas of water for copper 1/2 gram at once, or three do es of 0.3 gram fifteen minutes apart. If comiting does not occur, the copper salt should be removed by I wage. In emergencie a dess responful of ground must red started in a cup of topid water may serve as an efficient electic. At times it is de trable that the entire ali mentary tract be eleansed and for this purpose catharties should be em pl ved. They need not be given bowever until the most acute vimptoins have subsided. The siline catharties are to be recommended for this purpose only catharties in general should be avoided. Enemas are of little value

Administration of Antidotes—An antidote neutralizes the action of aposon either by changing its physical state or its chemical composition, thereby preventing its action or retividing its absorption. Since the compounds formed by administration of antidotes may be only slightly less toxic than the original poison or may become poisonous by remaining in the stomach, the gruing of antidotes should be combined with larage or the administration of emetics. If lavage is practiced, the autidotes may be added to the wish water, if emetics are used, antidotes may be added to the wish water, if emetics are used, antidotes may be added to the wish water, if emetics are used, antidotes should be given repetitedly at short intervals. In the selection of an intidote care should be excressed that it be as harmless as possible and that the substance resulting from its action is practically userf at least temporant.

Some antidotes, like raw \(\epsilon_{now}^2\), acaeta, milk, boiled starch or flour, which
may be given in quantities as desired, act either by combining with the
purson to form an involuble compound—for example, eggs in the case of
metals, especially increus—or by enveloping the poison temporarily in an
impenetrable membrane, hence le sening absorption, accomplished in part
hy delaying the exit from the stomach. In the case of irritant poisons
these antidotes also tend to illay inflammation.

One of the most valuable antidotes is tannin which acts as a precipitat ing agent. This may be employed in the form of very strong hot tea which may be given ad libitum. Alcohol diminishes its efficiency since the precipitates formed are, for the most part, soluble in alcohol The following antidotes will be found useful against specific poisons 4lkaloidal poisons-fifteen drops of tincture of iodin in half a glass of water Barium-either sodium sulphate (Glauber a salt) or magnesium sulphate (Epsom salt) Oxalates-calcium, either in the form of chall, limewater or whiting Phosphorus-copper sulphate or old turpentine Acidsweak alkalis, such as chalk baking oda, soap hurnt magnesia Alkalisweak acids, such as vinegar or lemon mice. Alkaloids glucosids and phosphorus-antidotes for these poisons are oxidizing agents which tend to oxidize and hence to nullify the action of the poison Potassium per manganate, about two grams of the crystals in a glass of water, repeatedly given if vomiting occurs or at least a liter of a 0.05 per cent solution In no case should any undissolved crystals be administered For hydrocuanic acid poisoning potassium permanganate, hydrogen peroxid or sodium thiosulphate may be employed

In treatment of poisoning the hypodermic administration of antidotes is sometimes useful thus for hydrocyanic poisoning sodium thiosulphate may be employed and sodium carbonate may be injected to counteract the action of acids. After poisons have had opportunity for all orpiton attempts to hasten elimination are sometimes made. The results have not been highly successful. At times, however, some of the measures to be employed are of value. It is of course evident that stimu

lation of the renal function will undoubtedly and in ridding the body of porson. In choosing a dispretie it hould be remembered that water is the last directic known. It should be given in large volumes from four to eacht liters in twenty four hours of maximum beneficial results are to be realized. Hypodermic injection of 0.9 per cent solution of sodium chlorid repeatedly given in liter quantities will also increase urinary Intrivenous infusion of the ame solution may at times be employed Venesection may be of value in some types of poisoning but the blood drawn (up to a liter) should be replaced unmediately by an qual or double volume of rectome salt solution

Another class of antidotes is the so-called group termed physiological antidotes or physiological antagonists. The e autidotes do not really nullify the effects of pursons, they merely mak the symptoms produced They are employed only against absorbed por one and tend to combat the symptoms produced by arousin, the opposite action. In this way they sometimes are of value in carryin, the patient over a critical period and aid in conserving life some of the physiological antagonisms are atropia to pilocarpin caffein to morphin, strychim to meotin, chloral to strychim

atronin to mornium, chloroform to strucham etc

Symptomatic Treatment -In most cases of potenting, symptoms produced by the absorbed porson are the most dangerous and the o should receive attention from the lanming of the treatment. One of the first functions to fail is the respiration Treatment to sustain respiration should not be delayed mutil respiration has actually ees ed but reflex stimulation of the respiratory center should be begun as soon as any evi dence is given of the weakening of respiration. For this purpo e use mis la made of inhalition of ammonia water or smelling alts or ad ministration of aromatic spirits of aminonia (half a teaspoonful in a glass of water), whipping with net tonels mustird plasters etc. Or if desired against to act directly upon the respiration may be employed such as hot coffice, atropin (0 001 gram) or strychnin (0 002 gram) If none of these measures is effectual artificial respiration should be practiced in a manner to avoid in mry to the hines

In certain types of asplaytating gas such as CO oxigen inhalation alone or inhalation of oxygen with small percentages of CO2 may be of

benefit

In attempting to stimulate the poisoned heart intravenous infusion of isotome salt solution alone or with the addition of epinephrin (1 100 000) my be of this Dilatation of the heart my be relieved by renesection The patient should be kept quietly in bed cooling presented by application of heat pain controlled by analynes convulsions counteracted by chloroform and come combated by stumulants such as coffee or stropin

For poisoning eases the following augmention by Sollmann is highly recommended

Administration of Antidotes—An antidote neutralizes the action of a porson either by changing its physical state or its chemical composition, thereby precenting its action or retarding its absorption. Since the compounds formed by administration of antidotes may be only slightly less towe than the original poison or may become poisonous by remaining in the storneth, the giving of antidotes should be combined with large or the administration of cinetics. If lavige is practiced, the antidotes may be added to the wash water if emetics are used, antidotes may be added to the wash water if emetics are used, antidotes may be added to the wash water if emetics are used, antidotes should be given repeatedly at short intervals. In the selection of an antidote circ should be excressed that it be as harmless as possible and that the substance resulting from its action is pretically interf at least temporarily.

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measures to be employed are of value. It is, of course, evident that stimm

strated even on microscopic examination, for it affords an opportunity to determine whether death can be ascribed to natural causes event that the organs and tissues reveal no pathological aspects, suspicion of poisoning is even more firmly established

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Antidotes for First Aid -Every physician following antidotes together in a special satchel ('Antidote Bag') so that they can be readily transported The dose should be written on each container Amyl intrite pearls, approprint tablets, 2 mg, arrown tablets, 1 mg , caffem sodium benzo ite, chloroform, cocam hydrochlorid tablets, 0 03 gm , tincture of iodin, copper sulphate, powdered, lime water, magnesia, calcined, potassium permanganate, 1 per cent solution (to be diluted twenty times), sodium sulphate, spiritus ammonire aromaticus, strychum sulphate tablets, 2 mg, whish, also a hypodermic syringe in good order, and a stomach tube with funnel The following should be demanded at the house of the patient boiled water, coffee (strong, hot, and black), eggs, hot water bags, milk, mustard, salad oil, salt, soap, starch, boiled, tea, vinegar"

In criminal cases of poisoning the physician should carefully note and record the symptoms observed and take possession of any suspected substances such as medicine, food, drink, and he should also preserve vomitus, urine and feees. In the event of an autops, where a chemical analysis is anticipated it is desirable that the chemist be present. In this way much more satisfactory correlation may be obtained in tracing the origin of the organs than if they are delivered to the chemist by the physician Moreover, the chemist will also be able to testify that the vessels contain

ing the orgins and tissues are chemically clean

In many instances it is deemed sufficient to examine the stomach and intestines for the presence of poisous. This, however, is not adequate practice. In addition to the tissues mentioned, portions of all the prin cipal or, ans, including the brain, cord and urine of bladder, should be scenred, especially if the nature of the poison is unknown. In the event that a quantitative estimation of the poison is called for, the total weights of the organs selected should be determined. The various organs and tissues should be preserved in separate vessels without addition of antisepties and the chemical examination should be hegun as soon as posible after the antopsy, although in most instances poisons do not rapidly disappear from the body after death. On the other hand, poisons that are gaseous or readily volatilized may disappear very rapidly after death

The antopsy itself may not reveal the cause of death. Indeed, in most eases of death by poisoning, the autopsy fails to show the cause of death In this event chemical examination is relied upon to furnish the proof At times even this fails, for the poison may have been largely eliminated and exist in any particular organ in quantities too small to be detected by present-day methods or it may be a poison for which there is no specific chemical test. In most instances, however, the chemical examina tion may be relied upon to give the desired information

The autopsy is of great value in suspected poison cases, although no evidences of poisonous action on the organs and tissues can be demon

strated even on microscopic examination, for it affords an opportunity to determine whether death can be ascribed to natural causes. In the event that the organs and tissues ereval no pathological aspects suspicion of poisoning is even more firmly established.

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#### CHAPTER IV

## THE PRINCIPLES OF MEDICAL CLIMATOLOGY

# HENDY SEWALL

Scope of the Subject —In its physical aspects, climate is determined by the facts of meteorology, or seience of the atmosphero, and this in turn is inseparable from physiography, which pertuins to the structure of the carth, and the distribution of its various features. According to the ann, 'by climate we mean the sum total of the meteorological phenomena that characterize the average condition of the atmosphero at any one phase on the succession of phenomena whose complete cycle, recurring with greater or less uniformity, every year, constitutes the chinate of any locality. Climate is the sum total of the weather as issuably experienced during a longer or shorter period of time at any given sesson'

But in ordinary usage the word climate inevitably suggests a relation between the physical conditions of earth, air, and water to be found

in any place, and the sensations and activities of man

The vital relations of the physical elements of climate are nell illustrated in the distribution of the various forms of animal and plant life. Man himself, through his ability to make fire and clothing and to command food, has been able to adapt himself to the widest extremes of climatic conditions.

When a plant or an unual flourishes in a given locality, its orgins and functions are said to be adapted to the conditions there found. To a great extent such forms, or their descendants, may be brought, by grad

ual change, to live in a totally different environment

This adaptability of living beings to widely different external conditions, through which forces which were once destructive become again conservative of life, depends upon a physiological reaction of the living organism to the influences acting on it. The physiological reaction of protoplasm to internal and external agencies determines the nature, the distribution, and the evolution of all forms of life.

As we view the races of men in their liabitats, from the poles to the equator, it is obvious that the differences between them are more or less dependent upon adjustment to their various environments. This ad-

justment involves not only the externals of clothing, the struggle for food and the general babits of life, but strikes into social and moral relations and results in anatomical differences at least of form and color. What may be called physiological climatology seeks to determine what are the total reactions especially evoked in various climates what functions of the body are specifically stimulated or soothed and what may be the effect, on the organism as a whole of any definite climate. Human bistory is still too brief to enable us to certify whether limitations of physiological adaptation rigidly restrict the geographical distribution of a given race of men without fundamental change in their ethnographic climateters Caucasian peoples are rapidly claiming the whole earth, and it is a matter of urgent moment to learn the natural adaptations they must acquire to conserve best their precumence under use conditions.

Until recently the problem of physiologic adaptation to climate has been inextricably confused with the incidental effects on man of the climatic distribution of prihogenic nucroorganisms. While the white man has acquired a certain degree of immunity against the infections common to temperate zones he is so succeptible to the disease provokin, organisms teeming in the tropics that no fair opportunity has been allowed for his normal development in such regions. The mirritions of the white race have been limited by the geographical distribution of pathogenic protozoa, and of certain insects which serve as their intermediate hosts.

The extraordinary demonstration in Cuba the Philippines and the Canal Zone that the infections which had threatened the lives of strangers in those regions are rigidly under control of Sanitary. Art for the first time gives the immigrant opportunity to adjust himself to tropical conditions. Enough has already been learned through the health reports from such localities to make it probable that morbidity and mortality among healthy adults at least are not essentially increased or accelerated by residence in tropical chimates '\$ Celemos sits. Vany—almost the majority—of the ordinary infective fevers are most prevalent in the cool and not the warm seeson of the very.' In temperate climates the transmission of the most important infections depends more or less upon the intimacy of contret between the sick and the well and the application of fygiene involves a regulation of sociologic relations.

While these views of climatology have a broad bearing on ethnogeny and engenies interest is especially concerned with the influence of climate upon the sick man or van environment antagonizing the inception of disease. As the welfure of the human being in his conflict with disease depends in general on physiological reactions which lead to development of compensations adaptitions or antidotes within the organism it is obvious that the study of medical no less thin physiological climatology has to do with vital reactions to climate conditions.

The first step should afford a comprehensive view of the physical elements of clunate and the results of their combinations in actual climates Then should follow an account of observations and experiments upon the physiological reactions of normal beings to the physical conditions of climate, singly and combined Finally, consideration should be given to the natural distribution of discuses and to the effect of chimates and climatic factors in conserving or antagonizing the forces of the human organism in its struggle with disease. Medical chinatology must autoinitically shrink with the development of specific therapentics and preventivo medicine

It is important to realize that, while man moves and breathes in a gaseous atmosphere, the protoplismic units of which he is constructed are bathed in lymph which forms his true internal environment, the con stancy of whose composition is far more important to normal life than is that of the circumsubject air

When the normal alkalmity of the blood suffers a reduction there is immediate physiological reaction and the disturbance may be so profound as to destroy life. This condition of "acidous" is the result of obscure and probably diverse causes. It is desired here to express the suspicion that the physiological relations of climate are largely achieved through a modification of metabolism, one of the results of which is an altera tion of the acid alkali balance of the blood Similar results may follow stimuli as widely different as dict and psychic emotion. It is quite possible that physicle neal effects which we attribute to climate change are often directly mediated through such plasma changes as base been andiented

## METEOROLOGICAL CLIMATOLOGY

Climates owe their characters to the quantitative relations of certain physical elements the principal of which are (1) temperature, (2) atmos physici constitute or himselfer to which are (2) temperature, (c) scales there movements or winds, (4) soil, (5) water, (6) light, (7) electricity. As will shortly be seen, various other relations are of select importance. These are latitude, the geographical distribution of land and water, ocean currents, the existence of mountain chains and elevation above the sex jusolation, and atmospheric composition, including impurities Various factors of chimite atmospheric composition, melading impurities—various factors of climate
may have a different relative importance, according as they are viewed
as agents affecting the physical conditions of the earth, or the welfare of
forms of life upon it. The hologic importance of direct insolution and
of vands far outweighs the physical influence of these factors
Temperature—Probably the most important single factor of climate

is temperature With the sun vertical over the equator, a beam of energy

which covers a unit area of the eirth would be distributed over a progressively larger surface if deflected a bliquely toward the poles. It is said that the amount of solar energy tilling upon a given area along any meridian at middit a tries, approximately as the cosine of the latitude. Its sheat therefore, descends upon a tries area of the earth with increaing obliquity of the riss. Moreover a the shell of atmosphere enveloping the earth his through its water, content power of absorbing heat it is obvious that oblique rais, which pursue a longer atmospheric path are robbed of their heating power. Three conditions determine the insolation or amount of ealer energy received it any place.

1 The obliquity of the rays according to which less heat falls upon

a given surface obliquity increases with latitude

2 The relative length of day and night. The ratio of day to night increases with latitude in summer. As pointed out by W. L. Moor the rapidly increasing length of the day toward the poles during summer soon more than compensates for the decreasing angle at which the solar ravs strike the earth—so that during summer the insolation is actually more abundant at the poles than at the cupiets.

3 The absorption of solar enerty by the air. In dust free air the absorption of hett depends upon the presence of contained watery vapor carbon dioral and ozone. There is reason to believe that in the upper atmosphere above cleven kilometers the amount of ozone is appreciable and constant. With increasing obliquity of the rays more air is traversed and more heat theoried. Watery vapor and curbon dioxid have a specific absorptive noner for the longer rais of the spectrum.

INTENSITY OF INSOLATION AT DISFERENT COLAR ALTITLDES (MOORE)

Alt t d f th s	Rel t L gth f the P th f Ray th gh th Atm ph	It ty f I lt S f P p d l t th R y	It ty flait Brf ti
0	44 "0	0.00	0.00
J	10 50	0 15	0 01
10	- 0	0.31	0.00
90	7 92	0.1	01"
30	2 00	0.65	0 31
40	1 50	0.69	044
0	1 1	0-7	0.55
60	11.	0~	0.65
70	100	0.0	0.72
50	100	0~1	0.76
90	100	0 (8	0.78

Although the earth is actually nearer to the sim in the winter of the northern hemsephere than in the smamer the greater relative obliquity of the rays during the former season is the chief cause of its cold. In the

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metologic and physiologic relations. The atmosphere ilways contains more or less watery vapor. The amount of vapor which it can contain without condensation into higher particles increases with the temperature. A definite weight of water when evaporated will siturate a definite cube space at a definite temperature. The amount of vapor thus sustained is nearly indifferent to the gives already present. If the temperature of a saturated space be lowered, part of the vapor will be condensed. If the temperature rises, more vapor can be sustained. The following table represents the maximal quantity of water that can exist as vapor in a cubic foot of space at various temperatures.

Adulous Vilor IV & Cubic Foot at Various Temperatures

	Temperatu e	Numb of the of tque u hap i a tubi l ot	Temperatura	Number of Grain of Iqueo: lay r i C bl koot
100	ŀ	10 9	JO 1	19
90	F	148	20 I	19
80	F	109	10 I	0.8
70	ŀ	9.0	0 1	
60	1	.7	-10 F	0 3
u0	Г	41	-20 I	1 02
40	F	28	-	

The actual amount of vapor contained in a given volume determines the absolute humidity. This, as just seen, has a maximum which increases with the temperature. The ratio of the amount of vapor actually present to that necessary to saturate the space at a given temperature is known as the relative humidity.

Thus, if it requires ten grims of vapor to saturate a cubic foot of air at a given temperature, and but seven grains are actually present, the relative himidity is 70 per cent. The amount of vapor remaining the same, the relative himidity falls as the 6 unperature rises, and vice versa. These relations guin their importance from the fact that the rate and amount of exportition from a surface depend largely upon the capicity of the air for absorbin, moisture.

The lower the relative humidity the more powerful as the evaporations force. A knowledge of the absolute humidity of the air is sufficient for the purposes of the physicast, but the relative humidit expresses could none of more physiological importance. Are at high temperatures can be "tery dry," and still contain more moisture than cool air which is "very damp,"

The atmospheric humidity is determined by the psychrometer which consists of a pair of thermometers, the bulb of one of which is covered with mushin monstened with water. The mercury of the "wet bulb' in strument stands at a lower level than that of the "dry bulb' to an extent

determined by the rate of evaporation from the most muslin. The read ings of the wet bulb are thought to repri ent the "scauble or physical dispersatures more nearly than those of the dry bulb. The action of wind greatly accelerates evaporation a low degree of humidity which might be combetable in the still air of a room would be disagreeable in the moving air of the open. Some observers prefer to consider, not the relative humidity, but its complement, the "attraction deficiet, which is the percentage of vapor which the air lacks for its situration. The drying power of the air is differented by the percentage of watery vapor which is needed to saturate it. This at 30° C (66° F), with reliable humidity 80 per cent, the amount of water that can still be taken up is about the same as when the air temperature is 10° C (50° F) and its relative, humidity only "6 per cent.

In changing from the liquid to the gaseous form water absorbs a great amount of heat rendering it latent and insensible to the thermometer. This heat of vaporization is taken from the air and especially the surface, from which corporation occurs. When the vapor is condensed by diling temperature, its latent heat is returned to the air, and the cooling by that extint is checked. The deep point is the temperature at which lapor is condensed upon surfaces chilled by radiation below the satura.

tion temperature of the sir

The absolute humidity of any region depends, in general upon the extent of water surface, including the moisture of regetation exposed to evaporation. It varies but slowly from time to time. The relative humidity, on the other hand rises and falls rapidly inversely with tho temperature. It is higher in the morning than in the afternoon capacity of the air to hold moisture rises with the temperature. The rate of evaporation decreases with the ri o of relative humidity but in creases with the temperature of the moist surface and especially with wind movement which removes the lumid layer of air in contact with it Evaporation 1 increased in high altitudes both because of the lowered barometric pressure and by reason of the low per cent of moisture in the air As the amount of water which the air can bold depends a pon the temperature of the latter and as the temperature rapidly duminishes with altitude it follows that most of the vapor is confined to the lower lavers of the atmosphere About half the waters vapor has below the level of 6 .00 feet and nine-tenths below 21,300 feet of altitude (Hann) The intricate and profound relations of heat and moisture to physiological functions will be dwelt upon in a subsequent section. They largely regu I to both the metabolism of the body and its sense of well living

Fau is due to the condensation of the vapor of the atmosphere when it shelled to the dex point. The tiny droplets thus formed coalesce to a greater or less evitest k force they fall. Solid particles suspended in the air under ordinary conditions serie as condensation centers for the run drops. It is said that in saturated, dust free air condensation may

Rum washes and purifies the air and becomes of great hygienic in portinee to the atmospheres of large cities. Rum is more abundant in warm than in cold countries, and in regions where large surfaces of water are expe ed to craporation, provided the conditions for sudden chilling in the upper air ire pre cit, as on windward shores and in hill ditricts. Mosture laden air, on striking a range of mountains, is deflected upward, and, being cooled, is apt to precipitate its moisture as rain on the wind ward side.

Winds.—The chief cure of wind is an inequal heiting of the air.

Air expands or contracts by 17/491 of its volume for every degree Fahren heit of rising or falling temperature. Warm in its specificilly lighter than cold ur, and when misces of air at different temperatures are contiguous, they move down or up with velocities determined by the difference of densities. The foundation of wind on temperature is simple in explanation, but fundamental in importance.

A patch of sandy soil gets hotter under the sun than a surrounding surface of clay The superior radiation from the and heats the air just above it, and the heated air ri es as if in a chimney, the cooler sur rounding air continually pre-sing in and replacing it at the surface, to be warmed in turn. The column of expanded air, on reaching a greater or less height, flows over upon the surrounding bed of cooler atmosphere Wind is the movement necessary to the re-toration of equilibrium of density throughout the atmosphere. As aqueous appear is specifically lighter than either ovegen or nitrogen, a given volume of moist air is lighter than that of dry air at the same pressure and temperature. Hu midity is, therefore, a cause of winds Winds are classified as perma nent, periodic, and non periodic. 'To the permanent winds belong the trade winds, the antitrides, and the prevailing westerlies of high late tudes, to the periodic winds belong monsoons, land and sea breezes, moun tun and valley breezes to the non periodic winds belong the high winds that accompute cyclones and anticyclones, including the hurricane of the West Indies, the typhoon of the China Sers, the simion of Arahia and Africa, the sirocco of Italy, the folm winds of the Alps, the chinook winds of the northwestern pirt of the United Stites, the mistral of Eu rope, the Texas northers, the blizzards and the hot winds of our western plans, tornadoes, the thunderstorm gusts, whirlwinds, and many others' In this article only the general features of the subjects can be discussed

Warmed air rises as it explude and cooled air descends as it con tracts. The contrast between currents of different temperatures is particularly obvious where they are confined, as among the slopes and valleys of a mountainous region. Uniform terrestrial wind inovenents largely depend upon the heating of the air in equatorial regions. A

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vertical motion is thus given to the medium and the air being heaped up in the higher altitudes, flows off north and south to about latitude 30°. where, having become denser than the supporting medium it descends to a greater or less extent in a vertical direction. Air currents on the sur face of the earth have, of course the reverse direction to those above The dense air of the polar circles flows equatorward until it meets the surface currents moving poleward when it ascends vertically to be dis tributed again according to the relative densities. As Phillips puts it The final re ult would be surface winds on the equatorial sides of latitude 30 toward the constor and on the polar sides toward the poles surface winds within the polir circles toward the equator regions of variable winds and calms at the equator latitude 30 and the polar circles The circulation however would still be along meridians These ideal relations are somewhat changed by the axial rotation of the earth As the actual velocity of rotation on a meridian increases from pole to equator a mass of air moving southward is in the northern hemisohere left behind its appropriate meridian and becomes directed southwest The result of this motion is seen in a deflection of meridianal currents so that in the northern hemisphere north winds become northeast and south winds become southwest in direction. In the southern hemisphere the defications would be complementary

The so-called trade winds of lower middle Intitudes have their explanation in such rotational deflections of mendianal currents. Such relations hold well over the overns but the modification of temperature conditions over continental areas and especially the obstructive and cooling influence of mountrium runges complicate the actual vaid movements.

The orderly connection between temperature, and wind is familiar in the daily land and sea breezes on the coast line of any large body of water. The specific beat of lend and water being about as 1 to 4, the land is rapidly heeted in the day time, and the air expinding, above it flows sea ward in the upper rigions. The rooker air over the water takes the reverse direction along the surface thus giving rive to the tempering sea breeze of a summer a day. At night the land rapidly loses heat by radia tion, and the air above it becomes more condensed than that above the water. The result is a nocturnal land breeze which lasts until temperature equilibrium is a givin reached.

Gyclones and Integelones—During summer the excessive heating of continental ariseleds to the giver time of upward air currents main hundreds of miles in diameter. The lower t barometric pressure under such an expanse of upward motion is about at its center. The dener surrounding atmosphere flows in from all directions along the surface toward the point of lowest pre sure. The actual direction of wind movement, however is not reduct toward the "fow center, but, following the law of mendiuml motions, the earnersh in the northern hemisphere take

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## THE PRINCIPLES OF MEDICAL CLIMATOLOGY

a circular direction opposite to that of the bands of a watch. Such a system of wind movement is known in meteorology as a cyclone. Con exceedly, when a column of tur becomes heavier than the atmosphere in general, as commonly happens over continents in winter, the denser air moves vertically downward and passes outward along the surface from this center of high harometric pressure. For obvious reasons, the direction of wind motion in such a case is, in the northern hemisphere, like that of the hands of a watch. Such a system of wind movement is known as an anticyclone. The physiological effect of the cold, dry, pure air thus brought to the surface is one of invigoration. The reader is referred again to the compreheusive work of Moore for a graphic account of the meteorological bearings of this subject. Winds are of very great importance in medical climatology. They may firmish in turn the most grateful relief from the depressing effects of hext and moisture, or render an otherwise enjoyable climate unbearably rigorous.

Altitude -The factors of climate are more or less modified with elevation above sea level The weight of the atmosphere and, therefore, the barometric pressure decrease progressively in a vertical direction from the surface of the earth. When the barometer reading at sea level is 29 97 mehes Hg, at an elevation of 5,000 feet it is about 24 97 inches, and at 10 000 feet 20 39 mebes The rate of fall decreases progressively In the first 1,000 feet of elevation the pressure is lowered by 1 15 inches Hg, in the tenth 1,000 feet by only 0 77 inch Hg According to Boyle's law, the volume of a gas varies inversely with the pressure, the tempera ture remaining the same Therefore, the atmosphere is progressively rarefied with increasing altitude, the proportion of its constituents remains the same At an elevation of about 3.5 miles, or 18,480 feet, the pressure is reduced to about balf that of sea level Permanent human habitations occur at altitudes approximating this (over 16,000 feet in Thibet and Bolivin-Hann) As the weight compressing the air decreases with elevation, air expands, and in expanding absorbs from the surroundings heat which becomes latent because doing the work of expan sion. On returning to a lower level this latent heat is given off again when the air reaches its original volume Dry air falls in temperature about 1° F for every 183 feet of elevation When the air is moist this relation is disturbed by the latent heat set free from condensing watery vapor Over the equator continuous snows are found on mountains at an altitude of 18 000 feet The snow level north and south descends with increasing latitude and varies with the season. Mountain tops are said to be cooler than the free air about them, though the rate of temperature decline is less on mountain slopes than in the free air, and over elevated table lands the temperature decrease is much more gradual. The u.eful ness of these facts depends upon their adaptation to surface conditions at verious elevations

Watery vapor follows the law of expanding gases and decreases per volume of air with secent, moreover, the amount held in solution is reduced by the lowered temperature (see table page 174)

Solid particles, which form an adventitions but constant constituent of the atmosphere at low levels, decrease with ascent above the surface. The air upon high mountain slopes has been found free from dust and bacteria. The result of these conditions has more physiological than physical value. Vegetation is sharply himited, owing to the falling tem prature on the slopes of high mountains as shown by the 'timber line' which is higher on southern than on northern exposures.

Pure, dry air is nearly disthermanous Solid particles carbonic and and especially water in suspension are the atmospheric elements chieffly capable of absorbing heat. We therefore find that their reduction in elevated regions is manifested by increased intensity of insolation. A surface capable of absorbing heat becomes excessively warm under the suns rays but, the air being cold, a thermometer placed in the shade shows a low degree of temperature. The heat absorbing constituents of the atmosphere also operate specifically upon the less refrangible rays of the spectrum. Therefore, solar heat and light are not only more intense in the clear air of high altitudes, but the proportion of chemical rays is grater than at see level.

The science of acrology has achieved such rapid development that in vestigators are more and more confidently using its data in the explanation of puzzling records of goologic events such as the gleical epochs

While meteorology may be considered a parent of elimetology their interdependence must be worked out empirically for every complex of conditions.

The present status of our knowledge is well set forth in the recent monograph of Humphreys. He writes "The atmosphere is divisible into the stratosphere and the tropbosphere or the isothermal region (with a temperature of about minus 22. C) and the convective region or in other words that region in middle lixtudes at and become alove eleven kilometers above sea level where because of freedom from vertical convection ordinary clouds never form and that other or turbulent stormy region below this level which is frequently swept by clouds and washed by snow and rain

Soil.—The nature of the oil found in any locality is an important climatic factor. Soils differ greatly in their capicity for absorbing and radiating heat and for holding water. I stimating, the capicity for heat absorption and radiation of sandy limestone at 100 that of pure sand is 90 that of various claps agains from of to 77 while that of limins is only 49. It has been found that a layer of sand half an inch or more thick on marshy ground o increases its absorptive power that the radia tion at night suffices to prevent the freezing of crops that would otherwise

suffer The greate trungs of temperature is found where the land has the greatest power of absorption and radiation, as over deserts. The character of the soil has e picual importance in its relation to the ab-orption and retention of water. Sand absorbs water most readily, but allows it to percolate rapidly. Therefore, a sindy surface quickly dries after a heavy rain, unle s underlaid by an impervious layer. Clay absorbs water with difficulty, and pives it up slowly Humus has extraordinary capacity for absorbing water, which it takes up slowly, but retains strongly Damp soils are those which retain or present the percolation of water. Cultiva tion of the ground greatly enhances its capacity to store water atmo pheric humidity viries with the mor ture in the soil and the tem persture relations of the air approach in court degree the e found over water surfaces. The reflecting powers of the ground covering are of physiological moment as witnes ed in the glare from sands de erts on the one hand, or mountain snow fields on the other

Electricity - Flectricity is a chimatic factor of unknown value. It is aid that the atmosphere is a wally positively electrified with regard to the earth, and that the open air is positive to that within dwellings During run storms the air charge is said to become negative. In the dry air of clevated regions the hon e dweller is often punfully reminded of his electric potential by the shock that follow his touch of a grounded conductor

There may be truth in the popular conception that ozone has important climatological relations. It is a powerful oxidizing and purifying agent It is formed from oxigen under the influence of electric dis charges produced by many and various meteorologic and telluric conditions, or by the action of ultraviolet ray. In general, its presence in dicates the absence of organic pollution, and is associated with a bracing

physiological effect of the air

In the presence of moisture and at ordinary temperatures it quickly reverts to ordinary ovegen, but at very high altitudes, where the tempera ture is about minus 55° C, it is supposed to be formed under ultraviolet radiation from the sun and its condition is far more stable

Composition of the Atmosphere -The composition of the free air in different places is remarkably uniform. This is given for pure dry air by Moore in the following

COMPOSITION OF THE ATMOSPHERE

=======================================	By Vlm	By W ght
Nitrogen Oxygen Argon Carbon dioxid	78 04 20 9.) 0 94 0 03	7. 46 23 19 1 30 0 00
Chippi mere	100 00	100 00

Other gases, such as krypton neon, etc, which occur in small amounts are without known effect. A small true of ammonia important to plant life, is said to be normally prient. A most important and variable constituent is witery vapor which ringes in amount from 3 prient of solume in the dampest agont to a vanishing proportion in the direct. The percentice of the different components of the atmosphere with the exception of the witery vapor, is practically unchanged by altitude. Barometric Pressure—This is the sum of the partial pressures of

Barometric Pressure—This is the sum of the partial pressures of all the gases in the strono-phere While the total pressure is due to and measures the total weight of the ant-one supporting the mercural column the pretial pressures of the various components of the air do not exactly measure, their relative weights. I quality between pirtial pressures and weights would hold if the percentages of the gases present remund constant throughout the atmospheres but when the percenting of any substance decreases with elevation, the pressure it everts is correspond might greater than its own weight. I has the pressure of water vapor at the surface of the earth is about six times its weight or sixfold what it would be if the likes were not present?

The atmospheric pressure at ea level in fair weather is usually represented by a merceinal column 700 millimeters about 30 inches high The pressure deer uses regularly with distude but its decline is affected by latitude, tumperature and humidity. The berometric fall for equal a Citils becomes slightly less with increasing altitude. Loughly estimated the berometry falls 1 rum for every 12 meters ascent or 1 inch for each

329 yards above sea level

Dust and Impurities in the Atmosphere—The hygienic relations of time pheric parity will be referred to leter. Freept in the uninhalited regions of high altitudes, and to a degree, over the occase dust particles including microorganisms are constantly suspended in the air. The air of large cities invariably shows headereds of thousands of dust motes to the caline centimeter, that of the village or town thousands and that of the open country at least hundreds. Light striking upon the sus pended dust particles is sentered in all directions. They are the clinic elements in the diffusion of dashight. In dust free air only objects would be visible which were illuminated by the direct rays from the sun or those reflected from visible surfaces. Thidall found in his experiments that the dust most difficult to remove was combustible, and therefore composed of organie matter.

The color of the sky the duration and colors of twil, ht are largely determined by the optical effects of du tmotes in the upper air. But dist owes its principal elimitological importance to the fact that its particles serve as the cendinastion centers which seem to be necessary to initiate the formation of droplets of mosture which give rise to fog

cloud rain, and snow

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## COMPOSITION OF THE ATMOSPHERE

	By V lum	By W ght
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Oxygen Argon	20 99 0 94	23 19 1 30
Carbon dioxid	0 03	0.00
	100 00	100 00

#### PHYSIOLOGICAL AND MEDICAL CLIMATOLOGY

The living organism responds to its physical environment each climatic factor has a preponderant effect upon one or another physic logical function, the fact that these functions are interdependent and that elimatic conditions vary more or less a a whole makes the study of physic logical climatology one of exceeding complexity. The ideal scientific pre entation of the subject would denote the relations between climate and the living organisms in the form of an equation On one side would be grouped the physical variables entering into the concept climate on the other side would stand the infinitely complex community of reacting cells of the body. The science of included elimatology must attempt to present the integral effects upon the second term of the equation of muta tions in the variables of the best. This underlying mathematical conception of the subject is manifest in the actual examination by the labora tory worker of the physiologic effect of the change of individual climatic factors Moreover, the mathematical point of view has definite practical value in that it reveals the futility of expecting a solution of the problem without a full knowledge of all the variables which enter into it.

The Physiological Reaction to External Temperature —Temperature is biologically the most dominant factor of climits. Metabolism of living is matter goes on within a narrow range of body temperature. Cold blooded animals whose chemical process or in large measure rise and fall with cetternal temperature have the plants, a googy uplical distribution strictly related to the thermal environment. Warm blooded animals react to valuations of external temperature in wha a way that, in general metabolism with preduction of hast is uncreased and loss of heat decreased by external cold, while the reverse reactions occur when the external temperature is:

By these means a nearly constant body temperature is:

maintained under wide fluctuations of air temperature

The hest of the body is due to katabolism or the breaking down of complex into simpler elemenal compounds in which process potential energy becomes liberated and Linter. The food is the fole which supplies the body with all its energy and there is believed to be an exact equility between the energy estimated as heat lost to the food in the body and that set free in the vital process a supposing the weight of the body to remain the same. Therefore the body in its metibolism is subject to the law of the conversation of energy.

Ob ervations on men confined in a calorimeter above exactly how much energy estimated as heat is lost to the body mider different conditions in a given time. It is obvious that to maintain the body unchanged it must receive in the food at least as much energy as it lows in its metabolism (for the full value of food etc. exclusive the full value of food etc. exclusive the full value of food etc.

The Influence of Vegetation on Climate - Porests have an important human interest in their efficiency as wind brakes. Radiation and evanoration are increased over verdure-covered areas and, therefore, the cen eral influence of vegetation is to cool the soil. The average humidity of the air of forests is several degrees above that of the open. The general effect of such growths is to conserve uniformity of temperature and moisture and to oppose extremes Only a few years ago it was generally assumed that vegetation, and especially forestation, and extreme importance both in increasing rainfall and in improving the capacity of the soil to absorb and rutain water. Deforestation has been charted with causing aridity of once fertile regions on the one hand, and with allow mg the rapid run off of excessive precipitation in disastrons floods on the other An unpremised analysis of chimatologic facts has led to the conviction that vegetation is only an effect and not a cause of rainfall Numerous factors are involved in the problem

Professor Willis I Moore finds that "In New England, where deforestation began early in history, the mean of the fluctuations in the ram curve is a steady rise since 1836 up to a few years ago, and in the Ohio Valley, where the forest area has been greatly dumunshed, there is no decrease of ramfall shown by the average of the fluctuations of the curve" He concludes "Procupitation controls forestation, but foresta tion has little or no effect upon precipitation. The run-off of our rivers is not minterially affected by any other factor than the precipitation Floods are not of greater frequency and longer duration than formerly' It appears that the capacity of soil to absorb and retain water is enhanced rather more by artificial cultivation than by mere vegetation. The binding

power of vegetation upon the soil is an important consideration

On the other hand, the existence and distribution of plant life are directly dependent upon temperature and humidity. Good crops are rused by 'dry firming' in regions, such as Colorado, where the rainfill is insufficient to support spontaneous growth. The main feature of the method consists in fine trituration of the surface soil. It seems obvious that lumping of the earth in masses would not only facilitite the develop ment of microscopic interstices, favoring a run-off of water, but would impede the penetration of the clods. On the other hand pulscrization of the soil would both annibilate its drumage channels and set each par ticle free to exert its maximum adsorption on the falling moisture. The distribution of plant life in general, other things being favorable, is determined by temperature ranges Plant growth does not take place until a temperature of about 43° F is reached The amount of growth depends upon the number of hours in a season in which the temperature is above this limit Of two places having the same mean temperature, one may be harren and the other contain a rich flora through favor of a short, hot summer

in climbing a certain height, which disappeared after the physical training of a summer. Training is the process of physiological adjustment necessary in pasing from one halist or environment to another. Every organism has its individual range of physiological response to the process of training. Somewhere on this scale, whether it be constructed on the basis of external temperature or any other climatic factor is a point at which, for the moment is found the optimism of physiological response—or that response which best on crives the well being of the organism as a whole. The numerical situation of this optimism varies with the individual and for the same prison at different time. Beyond the extremes of the scale life can no longer custs.

The essential thesis of this argument is that climate, in its broad sen e, is an indispensable factor in physiological therapeutics

The body temperature in man has been found by most observers to vir only within one degree during readence in opposite extremes of latitude. The necurses of most observations is impaired becaut the records have been obtained from the mouth or axilla. This uniformity of body temperature under different viternal conditions is maintained by coordination between the nervous mechanisms for the dissipation and production of heat. Accordin, to Vierordi, the relative loss of heat through various channels is represented in the following table.

RELATIVE LOSS OF HEAT THE RIGHT VARIOUS CHANNELS

Ch !	PCt	Cln
By urine and feces By expired air warming of air Vaporization of water from lungs By evaporation from skin By radiation and conduction from kin Total daily loss	1 9 7 9 14 5 73 0	4 00 84 00 189 190 74 190 1791 890

The relative values of these factors chang, greatly with external temperature and humidity. Thus in airm weither the low of heat result in, from the evaporation of perspiration rapidly unments. The nervous mechanisms involved comprise the requiratory center the vasomotor center the sent centers extent other exceptor centers and the various affected and efferent centers which connect them with the kin. The regulation of heat production models chaffs the motor nerve centers with the motor nerves of skeletal nurseles and the character and quality of the food ingested. Calorimetric experiments on men and animals show that the requiratory exchange may mend by the amount of oxygen absorbed and eirbon droud ethiled increases with full of external tumperature. In the case of man the incre of oxydetion through cold is inagquificant.

Parellel with the increased ingestion of heat producing food, physiological combistions are increased in the cold, otherwise the level of body temperature could scarced be maintained. The four fifths or more of the energy of miscular contraction which appears as heat, not to spak of the warmth from exculation friction, are important sources of bodilheat. All these facts hurmonize, with the ethine experience that, broadly speaking, the peoples of the higher temperate latitudes are characterized by physical energy and mental mutuative, while those of torrid zones exhibit a comparative bodily lassified and mental unitarity.

In actual climates other factors than temperature, notably humdity of the air, enter into the physiological problem and demand a special discussion

External temperature has a fundamental causal influence on body metaboli m It is a fair assumption that there is an optimum metaboli m at which machine efficiency of the organism is at its acme, and that this condition represents the most perfect attituable standard of good health for the individual It seems probable, though it does not follow of neces sity, that the ability of the tissues to adjust themselves to virying en vironment, and to produce the various biological antagonists against infections di case, should manifest an intimate dependence upon this phy iological efficiency. In short, what we term "the resistance powers of the body probably vary in some direct proportion with that harmony of metabolism whose optimum is manifested by perfect mechanical effi Such a view finds luminous exposition in the clinical experience that an environment of open air provides the body with a more or less specific resistance against the advance of certain infections-notably th berculosis It is commonly admitted also that tuberculous patients thruce better when they react to the cold of winter than when subjected to the heat of summer. It is fundamentally important to realize that the community of living cells forming the body is a moving system, reacting instantly to every change of environment. The resultant of such a physiological adjustment is subtended by a state of consciousness, a sense of comfort or discomfort, of well being or ill being This psychological condition is what determines man's estimate of chimate, and I assume that it is the natural and, on the whole, most reliable test of the con servative or destructive tendencies of underlying physiological activitie Our appreciation of a change is always measured by the state to which we have already become adjusted Thus, as Huggard points out, Ross and his party of Arctic explorers found the temperature of -29° to -25° F agreeable after they had been exposed to one of -47° F, and Pears's men complumed of heat at 26° I' after they had become accustomed to -13° F

Zuntz and his party in the Alps found that, in the springtime after a winter's mactivity, the guides suffered fatigue and metabolic disturbance

dents. The tendency is to a reduction in physiological tone, a lack at once in inhibitory force, and in active energy

Physiological Influence of Atmospheric Humidity —The watery vapor diffused through the air has extraordinary physiological importance not through specific action of its own but by modifying the effects of other climatic agencies, as heat cold wind, and light. The vapor of water in the air, like a body of water upon the earth tends to the preservation of uniform temperature Waters vapor absorbs and renders latent a reat deal of heat. The warmer the air the greater its capacity for sustaining vapor, and thus accommodating a reserve of latent ener, which must again become active when the vapor is condensed. Through at mospheric humidity the earth is thus screened from the extreme intensity of solar insolation by day and the earth is protected from extreme chill ing through reduction and evaporation at night. The air in contact with a coolin_ surface is suddenly narmed when den is precipitated. As already mentioned the drying power of the air is measured by the per centage of watery vapor which it lacks toward saturation that is, it varies somewhat invorsely with the relative humidity

It has been seen that the regulation of bods temperature in man in tolves the regulation of the loss of heat he the skin. In cold weather the skin is relatively dry and the radiation of heat is reduced by proper clothin, and the bidy wirinth is conserved on the principle of the domestic fireless cooker As the external temperature rises the skin circulation increases and the sweat glands give forth their watery secretion. The evaporation of the await removes the excess of heat from the bods. When the air is still the relative bannidity of the layer next to the skin is quickly rai ed so high as to impede further evaporation the air sums muggy, and the subjective sensation is one of profound discomfort A centle breeze brushes away the moist coating and the refreshing cooling process continues 1 stronger and especially when concentrated on a limited portion of the surface is apt to occasion such rapid chilling as to cause wide pread circulators disturbances which introduce a diversity of pathological conditions. Herein is a field for investigation which includes numberless phenomena, from the stiff neck that follows a draft to the 1m, list of respiratory infections that have some relation to surface chill. The discomfort occasioned by localized cooling of the body gives rise in miny people, to an justimetive aversion to drafts of air, which is worths of special inquiry Howell quotes a case from Zuntz of a man who possessed no swent glands In summer this individual was inexprentated for work since even a small degree of muscular retivity would em an increase in his body temperature to 40 C (104 F) or 41 C (10,8 F) This wonderful capacity of the body to regulate its temperature by evaporation was hown in the familiar experience of Blazden and Fordyce publi hed in the eighteenth if, by voluntary control, muscular movement and shirting are moded. Thus is manifest the purpose of the instinctive muscular activity induced by falling temperature. Rubner found the amount of CO climinated by a fasting guinea pig in air cooled to 0° C to be more than double what it was when at a temperature of 34 9° C (94 8° F), and this with a difference of but 12° C in body temperature.

The general conclusion from numerous researches on this subject is that the intrice of oxygen and output of carbon dioxid increase with lowering, and decrease with rising, temperature of the curronment. It is an interesting conclusion of Locky that "the only involuntary regulates of temperature in a main exposed to moderate cold is the skin." But the range of this coordination has definite limitations. Thus, both in man and animals, when the temperature of the culcrimeter exceeds 30° to 35° C (86° to 95° F), the combustions of the body increase beyond their magnitude at 20° C (65° F). The writer has found that talker culcuis guinea pigs seem to fail faster if kept at temperatures between 80° and 90° F.

It seems very doubtful if such increased metabolism would be found in acclimated individuals living, in the tropies. Pfluger made the interesting observation that, in a curriced ribbit, in which the muscles cannot be innervated, the gas exchange rises and fills with the external temperature as it does in cold blooded animals. The same effect was obtuned in paralysis following section of the spinal cord in the neek. It is a matter of medical interest to know that several observers agree that anesthetized mammals respond like cold blooded animals to alterations in external temperature. (The student of metabolism should consult the mistary change for Graham Lanks on The Regultion of Temperature)

The investigation of the effects of climatic temperatures, especially in the tropics, on physiological functions offers considerable difficulties. The conditions in hic countries are proue to be complicated by partistic infections. Thus, according to some observers, a decided degree of anemia characterizes the inhabitions of hot countries the number of rid corpuscles in the blood falling to half that normal in temperate zones. On the other hand, denizens of polar rigions are said to show plethora and polycythemia.

These conditions might be explained by ibundant illimentation on the one hand, and parasite infection on the other. The influence of warm countries seems to lower arternal blood tension. The rate of heir beat at the same time does not seem to be materially changed. Evidence, of doubtful value obtained at surgical operations and position/ten examinations, indicates that residence in the tropics induces a hyperemia of the sudominal organs, on the other hand, the lungs contrin less blood than usual. The general physiological effect of residence in hot countries seems.

to be epitomized in the muscular and nervous lassitude reported by resi

8 per cent of an atmosphere instead of a normal percentage of 11 to 17 (Locwy) It is therefore obvious that, as regards its content of O2 and CO, the alveolar air is not only practically identical outdoors and in but that under ordinary conditions its variations make no impression on consciousness Many years ago Brown Sequard and D Arsonval an nounced that the deleterious qualities of expired air depended upon poisonous or anic matter contained in it. They condensed the moisture in the breath of animals and impected the fluid obtained into other ani mals with fatal effects. Other observers repeating these experiments f iled to obtain the same results. Finally the whole question was submitted to an elaborate critical experimental review in 1895 by Billings Mitchell and Bergev The c suthors concluded that the ill effects of respired hir depended wholly on its temperature and humidity and not upon its increased content of earbon dievid or any organic inclusion Experiments conducted by the writer were recently instituted to de-termine whether a condition of sensitization could be induced in animals by confining them in pars ventilated insufficiently for their needs clusions were deduced as follows

Gumes pigs exposed to the rebreathed air, including entancous dust given off from other gumen pigs until its content in CO is sufficient to cause excessive dyspine; manifest in the majorits of evers, when exposed to the same conditions after the lapse of from twenty to eighty data in comparison with normal control numnals an exceptation in respirators disturbance which suggests amply licetor reaction

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From a noteworth, series of researches performed by Paul Heymann and Freklantz under the direction of Fluggs the conclusion seems justified that the subjective impressions that we have been accustomed to a cribe to disturbances of long sentilition really alpend upon modifications of skin ventilation. The observations were nived upon men confined in a clo ed chamler of three meters capitetts provided with an electric fair. When the air was kept in motion by the fair the subject under exp rument rumaned free from unples int sensations in air which measured by reduciny standards was excessively foul. When the fair was at rest and the air with the person confined in the clasmicer soon begin to suffer

#### THE PRINCIPLES OF MEDICAL CLIMATOLOGY

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century. These observers tested their own temperatures in rooms hested to various degrees. They found that the effect depended on the humidity of the air. Thus, after remaining fifteen mainites in a damp room hested to 54.4° C (129.9° F), the temperature of the month and mine was  $37.8^{\circ}$  C (100° F), but in a similar exposure in a dry room hested to 115.5° C (239.9° F) to 126.7° C (302° F), and in which bed steaks were being cooked by the heat of the iir, did not ruise the temperature of the body above the normal."

It is clear that the clust regulator of the body temperature, as external heat increases, is evaporation of perspiration, and that the rate of exporation is closely dependent upon the relative himmidity of the ur. The sensory nerves of the skin give fine warning of insufficiency in the physiological regulation through disagreeable sensations which we ascribe to imagginess or stuffiness of the air, and which are remedied, as will be seen later, by air renewal through "wentilation." When the external temperature falls much below that of the body, atmospheric humidity still has predominant interest, but in another direction. When the air is cold and its humidity high, the skul lose sheet to the mosture by conduction which accounts for the peculiarly chilling effect of damp, cold air. Wind has tust his loss of licent, so that it is clear how the wind my make a hot day more tolerable and a cold one less of

Ventilation —Perhaps the greatest chinical discovery of all time is the empirical determination of the hygienic and therapeutic value of the open air. We are not yet certain of the physicophysiological reactions which constitute the virue of fresh air.

Until recently it seemed elerr that the subjective appreciation of air purity was a question of high ventilation. It was then for granted that the 'bid air of a closed and crowded room everted its influence through a rise in CO tension and fall in O tension within the alveol of the large. Moreover, it was held that the expired air contained organic exerctions which imparted to it poissionis qualities. In short, the deleter ons effects of respired air were attributed to its chemical qualities. But Haldane and Priestley showed conclusively that, under a constitutions are pheric pressure, the tension of CO in the alveolar air remains practically constant. The slightest increase in such tension automatically stimulates the respiratory center to more victorus action. "a rise of 0.2 per cent of an atmosphere in the alveolar CO pressure being for instance, sufficient to double the amount of alveolar ventilation during rest." When a parson under observation was made to rebreathe the air evalued, he felt no abnormal subjective impressions until the CO percentage in the air inhaled began to exceed 3 per cent. These authors found also that diminution of ovegen in the inspired air produced no reflex effect on respiritory rhythm until its pressure full to a lout 13 per cent of an atmosphere, which corresponds to an alveolir ovegen pressure of about

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century. These observers tested their own temperatures in rooms heated to various degrees. They found that the effect depended on the humidity of the air. "Flins, after remaining, fifteen minutes in a damp room heated to 544° C (199° F), the temperature of the mouth and urine was 378° C (100° I), but in a similar expoure in a depreoment end for room heated to 1155° C (2199° F) to 1267° C (302° F), and in which bed steaks were being cooked by the heat of the air, did not raise the temperature of the hody above the normal."

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Humidity influences the output of heat from the body in two very discovering the cooling influence, and it interferses with the evaporation of per pira tion—a heating influence. What the net result will be depends upon which of these influences of humidity is predominant? It is pointed out that at air temperatures between 68 and 70° F neither high nor low humidities have marked physiological effects while the body is at rest. Thus, therefore is the optimum range of temperature for main taining the confort of inhibited rooms

Lee and Scott have recently reported experiments in which it was found that in cats confined for six hours in a ventilated box where tem perature and humidit, could be regulated at will the excised muscles at the end of this period showed a loss of work power when the air of the box had been maintimed at high temperature and humidity (01. F and '0) per cent) as compired with normal conditions. The sugar content of the blood diminished 0 per cent under the same circumstances

The present writer has pointed out as hid M J kosenau previously on the basis of experiments in anaphylaxis that substantial evidence crasts for the absorption by the respirator trate of protourn matter diffused in the air with the result of producing profound changes in cellular irritability. Therefore any practical view of centilation which ignores chemical pollution of the air is unseed the and dangerous.

Huggard quotes from Humboldt a striking description of the physical conditions produced by hot, damp climates. We had not yet been two months in the hot zone and already our organs were so sensitive to the slightest change of temperature that through abivering with cold we were unable to sleep and to our atsoinshment we saw that our thermometer registered 21 °C (71.24°F). A change of not more than seven or eight degrees sufficed to bring about the opposite constitution of shivering and oppressive heat

The temperature humidity and motion of the air combine to deter mine physiological reactions of the utmost significance to the welfare of the body. Thou, h the discomfort aroused by a poorly ventilited apart ment may not as demonstrated be due to discussed deterioration of the air nevertheless the e searchions of ill being be none of their value for hygeine prophylavis. The chinical experience which has demonstrated the debulitatine, effects of long continued confinement in close air as opposed to the invigoration attendant on life in the open finds explanation in the respective influence excressed by the two environments over the general resistance powers of the body. The skin is a peripheral sensory organ specifically concerned in maintaining the hygience of metabolism.

The Physiological Influence of Diminished Barometric Pressure— The mean pressure of the air at sea level may be assumed to halance a column of mercury 760 mm. about 30 inches high—The total pressure is from the headache, dizziness, fatigue, naivea, etc, characteristic of extremely poor ventilation. In this condition the priticit was allowed to breathe, through a tube fastened in the wall of the chainber, pure surfrom outside. No relief was experienced through this procedure, never theless, when the fair was started and the nir put in active motion, the person under experiment again became confortable.

Experiments by I conard Hill and his colleagues have confirmed Plugge's contention, that the subjective impressions aroused by led of centilation in closed spices are nowise dependent upon the cliencial constitution of the are breithed but rither on its temperature and its hunding, which interfers with the heat regulation of the body by restricting transpiration from the skin. The profound psychophisological influence of temperature constitutions derived from the skin is further evidenced by the currons fact observed by Boycett and Haldane, that when the air, whatever its real temperature, gave the impression of warmth of an impleasant kind, the tension of CO in the lung alveeli became lowered likely with the curron of the physical expressions of the feeling of warmth and shekness while the rise, in the CO tension (in the alveel) is associated with the general exhibitation and stimula tron produced by cold at?"

Rosenan and Arnoss write "Benedict has kept persons in his calorimeter breathing and rebreathing the same air with a CO content as high as 2 per cut for twenty four hours without discomfort, the only precaution being to keep the temperature down and to remove the

moisture "

Hough describes an experiment in which a subject was confined for an hour or more in an air right box. "The percentage of CO rose to for our parts per 10,000. When the observer opened the door the odor of the air within was almost overpowering, and yet, provided the water vapor was absorbed and the temperature of the box kept down, the subject of the experiment had not only been unconscious of this odor, but had actually suffered to discomfort." In his excellent essay the author clearly indicates the physiological relations of atmospheric humidity with rising temperature. When the air temperature rises above 70° F, the body temperature would become elevated, but for the exportation of perspiration. "When, however, owing to high limitality, evaporation is lessened, blood rushed in large quantities to the skin at the expense of the flow to other organs the temperature of the skin is raised, and so heat transfer by radiation, conduction, and convection is facilitated. The normal temperature of the body is approximately maintained, but it is at the expense of the working efficiency of other organs, and especially that of the brain. In these facts we probably find the true explanation of the dull, heavy feeling the difficulty of attention, and the discomfort both of the muggs summer day and of the errowded, ill ventilated room

wide limits without producing obvious reaction. Nevertheless when the partial pressure of oxygen falls to a certain level about 13 per cent of an atmo phere the tension of the ars in the lung alread is o lowered that the body cells suffer from the lack of oxygen

Physiologists have generally maintained that the respirators exchange between the alveolar air and the blood was regulated wholly by the physical law for diffusion of grees. According to this law, a greenist pass there is combinement of tension. But Haldane and Smith maintain that the tension of oxygen in the blood leaving the linux is much higher than that in the alveolar air and therefore, diffusion alone does not explain the nu sage of oxygen from the nir of the pulmonary alveola to the blood Haldane Don las Henderson and Schneider submitted the physiological suffuences of high altitudes to a circling mix tigation during a sojourn of thirty five days on the top of Pike's Peak Colorado (elevation 14 000 feet) They conclude that all the vital modifications writies ed at high altitudes are the result of one caus , lowering of the ovven pressure

in the air

They found, 'after a elimatization the resting arteral ovacen pressure had risen about 35 mm of mercury above the alveolar overen pressure. whereas at or near ex level the resum, arterial axigm pressure is no lugher than the alveolar oxygen pre sure. The raising of arterial oxygen pressure is attributable to secretory activity of the cells lining the lung ilvoh, and is a most important factor in the icelimatization. On breath in air rich in oxygen, the secretory activity was rapidly diminished The fundamental again once of this illeged oxygen secretion coordinate with the re piratory needs of the body in it well hold the attention. It has been shown by Juntz and others that the anboxidation of the traues risulting from a critical lowering of alveolar oxygen ten ion is accompanied by the accumulation of acid sub tances especially of lactic acid in the blood. These acid substances in the blood stimulate the respiratory center and lower its threshold of pritability for CO so that the cen ter is excited to work under the timulus of a lower tension of CO in the blood than would normally be effective

It seems probable that this not ils be de turbance, which is particular larly prone to affect newermers in high illutudes as directly re ponsible for many of the phenomena of mountain sickness. Mountain sickness is a curious sympt mi-complex manuf ted in various degrees by people who mount comparatively suddenly to land altitudes. In I prope the discrete send to e numerily immifest itself at elevations a low as 9 500 feet In America the critical level seems to be considerably higher. The subjective symptom an those of dy puer e pecually with exertion and a feeling of oppression in the che t

Di gust for food and n m er leiding to vomiting give name to the

the sum of the partial pressures of all the components of the atmo phere With elevation above sea level the fall in the barometer is measured by the mass of air left below. The rate of fall is approximately 1 mm Hg for every 40 feet of ascent in free air, or 1 inch per 1,000 feet. With ascent the relative proportion of the constituent gises is maintained, except that the watery vipor is chiefly confined to the lower levels. Were difference in atmospheric pre-sures appears, within wide limits, to be indifferent to living beings. The tension of the gises dissolved in the body flinds soon balances that of the surrounding air, so that the physical logical phenomena of a rarefied stimosphere cannot be properly assembed, is so often is done, to a suction pump effect upon the pulmonary apparatus although it is true, a given amount of gise confined in the intestince expands in proportion to diministion of external pressure

The importance of the time element in the adjustment of internal to external gas pressure is well illustrated in the phenomena of "cais on disease". In subaquatic constructions workmen in cuissons are sometimes subjected to air pressures of three or four atmospheres. On returning to normal conditions, if the decompression is too rapid, peculiar symptoms, ingling, cramps, etc., are experienced, and paralysis or even death may ensite. Postmorten eximination shows that air embods are set free in the central nervous system, leading to "necrosis in the region of the posterior and lateral columns of the cord, especially in the cervical region." Such pathological results are avoided by slow decompression covering a period of out to two hours. The physiological effects of high altitudes are probably all to be explained by the lowered pressure of oxigen, and possibly of carbon dioxid also, in the alveoli of the lungs. In the dry atmosphere, at 750 mm pressure, the partial pressure of oxigen is about 169 mm. That of carbon dioxid is negligible.

Zuitz and Loewy³ analyzed the air expired by human beings and calculated that the composition of alveolar air varied between the following limits oxygan between 11 and 17 per cent of an atmosphere, cur bor droud between 37 and 55 per cent of an atmosphere Or, in terms of tension, the partial pressure of oxygan ranged between 83 6 mm Hg and 1.20 2 mm, while that of eirhon droud varied from 281 mm Hg to 418 mm. Attention has already been called to the demonstration by Haldane and his associates that under ordinary conditions, the partial pressure of CO in the pulmonary alveol of a given person is remarkably constant. A very slight increase in the CO tension leads to hyperpaca and exaggerated elimination of CO, from the body while, on the context, a lowering of CO tension indicase physiological apnea, or re pira tory rest, and consequent accumulation of CO in the body. That is, CO₂ is the normal stimulus of the respiratory center. On the other hand, fluctuation of oxygen tension in the alveolar air may occur within

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Di gust for food and names leading to counting give name to the

disorder The sufferer is absorbed in his own misery, and the mental disturbance may proceed to temporary alienation. The skin and lips are blue, the circulation and respiration distressed, and the slightest exertion exaggerates intolerably all symptoms The inhalation of oxigen gas relieves at once, for the time, the morbid condition After a quet sojourn of two or three days at the altitude provoking the sickness, the body usually becomes accommodated to the new conditions, and a fair amount of exertion may be taken without undue distress. Cyanosis of the skin disappears, the lips again become red, and pulse and respiration return to about normal A review of the literature on mountain sickness would reveal a curious multiplierty of explanations for the disorder. The dogmatic statement may be ventured that the final cause of the symptom complex hes in an inadequate ovicen supply Haldane and his colleagues on Pike's Peak found that, when samples of the venous blood were shaken up with air driwn from the alreon of the lines, the blood remained dark, although, at the same time, the arterial blood must have been bright red, as shown by the color of the lips and mucous membranes of the subjects. This experiment indicates both that the oxygen tension in the alveolar air was at least no greater than that in the blood from the right

must occur under such conditions

Olinical experiences have led the writer to suspect that an important factor, if not the internal eventing cause, in mountum sickness lies in circulatory disorder resulting in accumulation of blood in the veause system through inefficient circulae action, proceeding to dilatation of the right heart, and, in extreme cases, to insufficience of the tricuspid valves. It is easy to believe that anoxemia would early depress the circulae function. This would lead to pletbora of the lungs and goveral tenous sisten, and provoke the symptoms characterizing the disorder. Unfortunately no opportunity has yet occurred to try out this theory experimentally, as by a study of the jugular and here pulsations.

heart, and also that active absorption of oxygen by the alveolar epithehum

Physiological study of persons and animals removed from low to high altitudes shows a profound alteration in metabolism, especially of the bemopioetic system. The ab-olute and relative amounts of hemoglobin and of the red blood-corpuseles are greatly increased at high altitudes Zuntz and his colleagues working on Monte Rosa, altitude 14,960 feet, showed that the activity of the red bone marrow, as shown by its hyperemia and increased number of nucleated red cells, was accelerated by low barometric pre sure. The number of red blood corpuseles has been found to rise from 5 000 000 at sea level to 6 000,000 at about 14,000 feet

The hemoglobin increases by 20 to 30 per cent or more under the same conditions

Haldane and his coworkers made a critical study of the blood as affected by barometric pressure. They found that "the percentage of hemoglobin increased for several weeks on the summit of Pike's Peak

and varied in various acclimatized persons from 115 to 154 per cent. The number of red corpus-les increa ed parallel with the hemoglobin? At high altitudes symptoms of anemia may attend a hemoglobin per cent that is normal for sea letel.

Much of the work that has been done in this field is held by Burker and his associates to suffer from defects in method. These observers muntain that the increase in the red blood count for moderate elevations, up to say, 1000 feet, is much less than his usually been asserted. Abichialden and others have considered the altitude polyeythemia to

be the result, not of increased blood formation but of blood concentration from excessive evaporation. Another view assumes that under low barrometro pressures there is an unusual accumulation of corpuseles in the peripheral vessels from which estimations are made. The excilent work of Lorenchart and his colleagues seem to have disposed of these doubts as to the existence of a true altitude, policythemia and the active stimulation of the blood forming organs through reduction in the partial pression of existence.

Locenhart confined rabbits in ventilated boxes in which, while the total birometric pressure was kept constant the proportion of oxygen was widely varied. It was found that under the ecuplations, low tring the oxygen tension produced blood changes simily to the evaluation when a like full in oxygen pressure was due to clevation above sealered.

Reflecting on the reason for these changes in the blood at first view there might seem a paradox of nature in the provision of an exces of oxygen-carrying material in proportion to the diminution of oxygen to be carried On the other hand the conception as incontrovertible that the hemoglobin of the body is not only a carrier but a storehouse for oxygen and the excess or luxus of this stored oxygen must be greater the lower the oxygen pressure in the alveolar air in order to meet the demands of muscular activity. The relation of this respiratory factor of safety to the nutritional demands determining a physiological dietary touched upon in a preceding section is not without suggestiveness. Bar croft and king have experimentally demonstrated the probability of hemoglobin serving in certain lower annual as a storchouse for oxygen. which is given up to the tissues as emergencies arise. The dissociation of oxygen from its carrier is greatly accelerated with rise of tempera ture and it is highly probable that the elevation of temperature occurring in active mit cles is a definite device of nature to make loose the oxygen when needed

As regards the coloriess corpu elss of the blood G B Webb and ha associates at Colorado Springs altitude 6 100 feet find that there is a relative and absolute meriase in the number of bruphoestes, including c pecully the large monanuclears in the blood of persons removing from lower to higher altitudes. Thes find that the proportion of lympho196

cytes rises from an average of 37 per cent at sea level to 44 per cent at Colorado Springs, and to 54 per cent at Pike s Peak.

O M Gilbert of Boulder Colorado, has repeated these observations at various altitudes varying from 9 000 feet above to 120 feet below sea level (in the Salton Sink of California) He found the highe t ratio of lymphocytes (4) 5 per cent) in the blood of persons residing below ca level At Boulder, clevation 5.380 feet, the proportion of lymphocttes was 42 6 per cent, at Phoenix, Arizona 1100 fect 41 7 per cent, at Gold Hill and Ward, Colorado, 8,000 to 9,200 fect, 40 5 per cent, it Airora, Illinois 500 feet, 38 b per cent. In short the results indicate that the lamphocytosis is not a function of altitude per so but of some other factor

Janet H. Clark refers to the lymphocytosis excited under certain ultra violet rays, and possibly the excess of the errys in the similable of special

regions completely explains the metabolic change

Insolation -In his haltitudes the intensity of in obition is great because the air holds but little moisture to alsorb the rays, for the same rea on, the heat radiated from the carth is not retuned near the surface but penetrates to upper levels. There is great difference accordingly between the temperatures of day and might, and between sun and shade In winter an invilled may sit comfortably in a solar temperature of 900 to 100° F, while a thermometer hung in the shade within arm's reach registers below the freezen, point. As it is the shorter wave-lengths of olar energy which are subject to atmo pheric ab orption, the light of clevated regions is peculiarly rich in the e chemical rivs. The inten e illumination is probably largely responsible for the restle suc a and irri tability witnessed in unacclimated persons at high altitudes

The physiological and psychic influence of light milks it a chimitie factor Major C E Woodruff charges the intense solar illumination with the cities, especially of the nersons system which make difficult the

residence of white people in the tropics

According to him light is the important agent in the production of neur isthema and multifirious allied nervous disorders, and persons of bloud complexion are especially subject to its evil influences. It seems highly probable that the debilitation unduced in the tropies is due rather to the combined influences of heat and humidity than to execusive illumina tion Light is indispensible to normal life, and, if its exect a leads to phys tologic disturbance, it becomes all the more imperative for the climater ther mentist to consider this agent specifically in his recommendations

The radiant energy of the sun is undoubtedly a powerful physiological stimulus, capille of working other good or harm to the body Heliotherapy is in an empirical stage such experiences as those of hollier in the cure of surgical tuberculosis under sunlight de erve critical con firmation Webb correctly urges caution in the application of the method

The writer saw one of his princits who had apparently circle himself of a secre ulcrative tubercula invengits by the daily application for a few minutes, of sunlight to his larger. The light was reflected by a pair of polished metal mirrors and guided by a larging-scope. It was presumed that the ultravoider rays probably excessive in the Colorido sunlight were the official agent.

The study of the with relations to light and especially to ultraviolet ranks has become an important and rapidly developing brain to fiphys is logical physics. Ed., ar Mayor his brought together much information

Under certain conditions visible light a sumes as drastic a physic

ological r lo as the ultraviolet rivs. As noted by Mrs Clark, it is possible to servetize hints cell just as one sensitizes a photographic phate, and produce an abnormal condition in which visible light is as active as ultraviolet. This phenomenon has been called photodrumine sensitization. Although a great in mis substances sensitize in with oally coun chlorophyll and certiful derivatives of homoglobul have so related in the interior factor essentially only the product of the interior way and the only marked is effective sensitizer for higher animals is homotoporphyrin. This sub-tance is derived from humatur by traviality, in a literature of the interior of hemitoporphyrin (ceur normally in the urine but the quartity becomes significant after his abuse of certain drag, as sulphand and trioral and in some people it is covered without obstons one. Such per one are suid to be exceedingly sensitive to hight upon the kin. An animal rand be wholly uniffected by the injections of his matery applyring in the dark while it soon succumbs to a much smaller doe of nimit mode ut the hight. Hausement up to dark time with it and found of 1 grant hiralises in the dark while the one as mirked but temp over hypermin of the curs no e and tail and after a period of grant activity the mirmal because quiet shows despine a and deep not him one with the higher mirmal because quiet shows despine a and deep not him to be three hours.

Such facts as these summer to him of investigation which may give to light an importance in medical climatology latherto underland of

It has already been stated that femperature take the first rank in determining the play obecaul relations of claimate. But it has being been clear that the feeling of heat, or so all temperature may vary which from the air temperature as meaned by the ordinary thermometer Lodeser W. W. Harrington of timer Chief of the U. S. Weather Bureau was apparently the first to defaultely point out that the cut atoms of temperature run much more marly purillel to the readings of the wet luib than of the dry luib thermometer.

Accordingly in dry air in which the heat of the body is carried away by evaporation or perspiration, the weather may be comfortable when at the same air temperature in a lumid livality the heat would be opprecytes rises from an average of 37 per cent at sea level to 44 per cent at Colorado Springs, and to 54 per cent at Pike's Peik

O M Gilbert of Boulder, Colorado, has repetted these observations at various altitudes varying from 9,000 feet above to 120 feet below see level (in the Sulton Sink of California). He found the highest ratio of lymphocytes (415 per cent) in the blood of persons residing below see level. At Boulder, clevition 5, 80 feet, the proportion of lymphocytes was 426 per cent, at Phenry, Arizonia, 1,100 feet, 415 per cent at Cold Hill and Wird, Colorado, 8,000 to 9,200 feet, 405 per cent it Aurora, Illinois 500 feet, 388 per cent. In short, the results indicate that the lymphocytosis is not a function of altitude per se, but of some other factor.

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196

Insolation—In high altitudes the intensity of in olation is great because the air holds but little moisture to absorb the rays, for the sume reason, the heat radiated from the certh is not retuined near the surface, but penetrates to upper levels. Here is great difference, accordingly between the temperatures of day and makit, and between sum and shade in winter an involid may sit comfortably in a solir temperature of 90° to 100° F. while a thermometer hing in the shade within rims reach registers below the freezing point. As it is the shorter wavelengths of solar energy, which is subject to interophere absorption, the light of clevated regions is peculiarly rich in these "chemical" rays. The intense illimination is probably largely responsible for the restlessues and irritability witnessed in maneculmated persons at high altitudes.

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to a condition known as pneumonokomosis Fibroid changes are induced to a constitution from the foreign particles and considerable areas of the lung tissue may be replaced by solid nodules, or masses of deeply stained fibrous tissue. Chronic bronchitis and emphysema are the characteristic clinical sequences The familiar miners consumption' is anatemically a pulmonary fibrosis. In the lungs of a stone-entter, forced to abandon his occupation on account of increasing dyspnea, the X ray plate showed me dense shadows radiating from masses at the roots of the lungs and involving the greater portion of the orgins. There was no evidence of tuberculosis in this case. I ungs so affected seem to lose much of their normal immunity against bacterial infection. In the mining regions of Colorado it is not uncommon to find superb athletes suddenly succumbing to an intractable form of pulmonary tuberculosis. It is not improbable that the high mortality from pneumonia witnessed in similar districts is likewise associated with dust inhalation. The intimate effect of in organic inclusions on the vital resistance of the lungs is emphasized by I M Anders, who quotes Sturfield's observations on occupation mortality in Sheffield the death rate of granders from phthisis is more than six times, and the death rate from other respiratory diseases nearly three times that of the average male while the death rate of cutlers from phthists is nearly three times and from other respiratory discress nearly four times that of the average male? The quality of the foreign matter inhaled seems not to be indifferent thus according to Osler coal miners are not especially subject to phthisi In his experiments on dust Tvn dall found the air exhaled toward the end of expiration to be free from solid particles, a fict significant of the amount of dust that must be retained In manufacturing centers the smoke from burning coal composed chiefly of carbonaceous particles with a considerable content of CO and SO probably has important relations to the nublic health sulplurous acid is especially irritatin, to the re piratory mucous membrane. Under the action of oxygen and moisture it becomes converted into sulphuric acid F W Schrefer calculates that there are daily dis charged from clumners into the air of London about 300 tons of soot,

These bodic are all much between this are and tend to settle. The solid pirticles at least form foer for the condensation of misture, so that fees impregnated with the gases of combistion are readily generated Statistics show that morbidity and mortality from re-piratory diseases are greatly increased during lavy fors in manufacturing districts. It has been calculated that steel dust from the brake-shoes of moving trains for merly permeated the air of the New York subway to the extent of our ton in a mile of the tinned.

90 000 tons of carbon drovid and 2 700 tons of sulphur drovid

The figures reported p obally should be modified as the result of the appl atlon of smoke consum: g devices.

sive Wind movement greatly enhances evaporation and the cooling effect of dry air. Isotherms plotted from readings of wet and dry bulb the mometers, respectively, differ widely in their course, and we find a physical explanation of the cooliness felt on entering the shade on a summers day in and regions. In the winter, by reason of the low humidity, little heat is lost to the body by conduction. Therefore, resorts in elevated regions tend to seem much cooler in summer and warmer in winter than places on the same purifiel near sea level.

Professor Cleveland Abbe points out that different individuals respond variously to the same physical environment, as does one and the same person at different times, as before and after cetting. Observing his own sensatious, with the wind blowing five miles an hour, he noted the following results.

INDIVIDUAL	REACTION	TO	PHYSICAL	ENTROYMENT

Tempe tue	Pel 1 vo 11 m d ty	Subjective State
80	20	Feels fine
40	60	Feels fine
20	80	Weather very raw
60	80	Comfortable
80	100	Suffocating

In his recent study of the influence of climatic factors on human time the preeminent place to temperature. He writes The law of optimum temperature apparently controls the phenomena of his from the lowest activities of protonlysm to the highest activities of the human intellect.

In an essay like this it is impossible to give a detailed discussion of the modification of physiological functions induced at high altitudes. The monumental works of Pull Bert of Mosso, and of Pinitz and his collaborators, together with the researches which have been cited here, represent the essentials of our present knowledge of the subject.

The scence and art of aviiton we developed in the late War do not appear to have, as act, added much to our knowledge of high altitude climatology. It was found necessary to subject conductes for a uniton to elaborate tests as to the celerity and range of their physiological accommodation to the conditions of high flaring.

Dust and Atmospheric Impurities — Impurities in the atmosphere in the form of dust and novious gaves, not to spenk of becterval and other contaminations, have undoubtedly great though little investigately, effect on human health. The lungs are the organs specifically affected. The solid particles inhaled to a greater or less extent, penetrate the bronchial mucous membrane and are distributed thence by the lymphatics, leading

But the mental state is still refractory to mathematical exposition, and practical clinicians are turning back to that viewpoint of life from which the mind is regarded as an ever acting and often predominant energy in

physiological proce ses

Midden writes 'The Stagerite who knew all things and treated of them and some others, in these weellest observations on the indispen able necessity of strenity of mand hopefulnes and even cheerfulnes of health of soul or body. When the change of climatic stimuli relieves minima analysis an interest in nuture or exercise zets for mental effort it tends to produce that cheerful screenits of which Aristotle recognized the value. The principles of chimatic treatment are founded on psychology as well as physiology.

# APPLICATION OF CLIMATE TO TREATMENT OF DISEASE

It would seem at first sight east to determine from empirical observation the clunatic conditions remedial for various pathological states. But experience hows that benefits which had apparently been originally derived from the clinite of some debnute localist finally car of to resund latered from the clinite of some debnute localist finally car of to resund brought into consideration. Lessorts for the tuber-ulous for eximple that once scemed sulutary, have time and again developed into hobbeds of the diseas. No fair estimate of the phission local militarience of the topic can be mide until infections incident it to the hot zone are under sanitary control. In short, the case as of the case must be understood before a securitie amplication of cliniate their-presents can be hoped for

Again, nuncee sirv obscurity has been thrown around the subject of phisological climatology is the frequent failure to recognize that, in every place mans of the phisucal factors of climate are subject to immediate artificial change to a degree which it would require long journess to realize by geographical menus. Temperature laumidity, air movement, unodation, are largedy subject to artificial regulation.

The one dieve involving consideration of chinatology is inherenlosis. The one dieve involving consideration of chinatology is inherenlosis. Therefore, the heat doubt was removed as to the rea on why resorts which originally seemed fivorable to recovery from the disease so often proved.

later to le dunger spots for its acquisition

Face the claums for the remedial powers of tuberculur the verts have welded but on only pen shile agant in the prevention and cure of tuber subsist—the open mr. It is currons but little the crudity of this claimed by ling his been refined. We have been at a loss for definite explanation of the hyguene virtues of open as compared with closed air. Referring to a preceding diener in on the physiology of ventilation the contention of F lings secuns sustained, that the morthal sen attor through which we Whate and Shaev found at extremely difficult to estimate the morbide influence of smoke in the air of manufacturing centers. They conclude, however, that there is a general tendency of the tuberculosis death rate to rise as the number of smoky days in the city decreases, there is a general tendency for the number of deaths from pneumonia to full as the number of smoky days in the city decreases?

It is obvious in estimating the hygienic relations of atmospheric in purities that these should be primarily divided into two groups according to their solubility or insolubility in the body finids. To the first class including sulplimic acid, etc., we might perhaps expect relatively scule physiological response. The second class operates slowly through structural alterations of the lungs manifested as more or less extensive pneumonohomous

A J Lanza of the National Health Conneil, has analyzed the data presented by miners consumption" as it occurs among the workers in the Jophin mines of Missouri. The mines produce lead and zine and the offending dust is siliceous from powdered flint. Miners' consumption is due to the deposit in the lings of solid particles, the irritation of which sets up a progressive fibrosis. The early symptoms of the disorder are a gradually mercasing dyspuea on exertion, diminished respiratory expansion and pains in the chest. Many of the vietims examined had been at work for ten to fifteen years, but it was not uncommon to detect signs of silieosis in those who had worked less than a year in the mines Somer or later the subject of miners' consumption is prone to develop either tuberenlous or progenic infection of the lungs or both. Out of 720 miners examined by Linza 433 had miners' consumption and of these 103 showed tubercle beeilli in the spita. The numerous X ray pictures of the clest which illustrate this research are strikingly suggestive of the plates obtrined in pulmonary tuberculosis of glandular and brouchial type with bilateral distribution of disease. In advanced cases the great mas es of shidow, which are visible on the A ray plates, can be distinguished from those of ordinary tuberculosis only through the lack of same of cavitation

The bigienic importance of this subject must be grantly enhanced one, to the inorganic dist, are added putrescable substances and pathogenic microorganisms. Moreover, if the conception of atmospheric pollution is broadened to include not only mert suspensions, but the humanisest which transport infectious matter, control of the purity of the air must banish much of the disease which now affects mankind. Wind and rain are the natural purifiers of the air, as regards accidental contaminations.

The Psychology of Climate —The demonstration within the past half century that the law of the conservation of energy applies to the metal-olisms of the hung body led to a mechanical view of vital processes which only incompletely represents the forces that control the human being

But the mental state is still refractory to mathematical exposition and prietred clinicians are turning back to that viewpoint of life from which the mind is regarded as an ever acting and often predominant energy in physiological processes

Madden writes The Stagvitte, who knew all things and treated of them and some others makes excellent observations on the indispensable necessity of screenty of mind hopefulness, and even cheerfulness for health of soul or body. When the chinge of chinatic stimuli relieves enimic avakens an interest in nature or events zest for mental effort it tends to produce that cheerful screenty of which Aristotle recognized the value. The principles of chinatic treatment are founded on psychology as well as physiology.

# APILICATION OF CLIMATE TO TIEATMENT OF DISEASE

It would seem at hest sight easy to determine from empirical observation the climatic conditions remedial for various pathological states But experience shows that banefits which had apparently been originally derived from the climate of some definite locality smalls ceased to reward the cekers of health so that factors other than the e of climate water brought into consideration. Peearts for the tuberculous for example that once seemed salutary have time and seven developed into hobbeds of the disease. No fair estimate of the physiological influence of the tropics can be made until infections incidental to the hot zone are under syntary control. In short the causes of disease must be understood before a scientific application of chimatic therapeatics can be hoped for

Again, tunice are ob curity has been thrown around the subject of phisological climatology by the frequent failure to recognize that in very place many of the phisoid frequent of climate are subject to immediate artificial change to a degree which it would require long journeys to realize by geographical means. Temperature, humidity, air movement insolation are larney, subject to artificial regulation.

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Tuberenlosis—When the pathog nic organism of tuberenlosis was discovered the last doubt wis removed as to the reison why resorts which orbinally seemed favorable to recovery from the disease so often proved

later to Ie danger spits f r its a quisition.

Pace the claims for the remidial powers of tuberculin the years have yielded but one indispensal le agent in the presention and cure of tuber calosis—the open air. It is curious how little the crudity of this clinical finding has been rafined. We have been at a loss for definite explanation of the his gene virtues of open as compared with closed air. Referring to a preceding discussion on the physiology of ventilation the contention of Flugge scens sustinged, that the morbod en utions through which we

recognize the impurity of respired air are not due directly to acquired chemical properties of the air, but to the irritation of certain sensory nerves of the skin brought about by a rise of temperature combined with a high degree of relative humidity. The nerves specifically concerned in these sensations would seem to be those delegated to temperature sen sations, moreover, in the clothed subject, the skin of exposed parts, the bead, neck, hands, wrists, possibly the linning of the nasal canal, would seem to be of relatively paramount importance. In explaining the main tenance of a constant body temperature under wide thermal variations of the air, we find no difficulty in averibing profound alterations in metabolism to stimuli arising in the temperature ucryes of the skin. From the same point of view the suggestion is charges that the sensations of comfort or discomfort aroused in "good" or "bid" air are but incomplete conscious expressions of tissue reactions which determine the molecular efficiency of the machine, and incidentally regulate the production of substances protective against discuse While heat and humidity are of predominant importance in the excitement of entancous sensitions leading to feelings of well being or ill being it would be a too narrow view which would restrict to the action of these physical agents the multifarious an sory impulses, largely operating through the consciousness of pleasure and pun, through which the metabolisms of the body are, I believe, largely ordered

Thus nature, through visual and auditory impressions, tends to generate an esthetic state, which is a potent addition to that mental at

mosphere which favors recovery from tuberculosis

It is worth while, in pressing to point out that the response of the body to the manipulations of hydrotherapy is, in large measure, but a demonstration of the physiologic influence of temperature and moisture on entirecous sensations

These reflections point to a physical basis for the known physiological effects of life in the open, and make it concentable that all the advantages of such an environment might be seemed indoors under artificial regulation of temperature, humidity, air movement, illumination, and other

factors, physiologic and psvelue, of the outside climate

In short, the facts point to the conclusion that the "resistance powers" of the body, aside from those specific immunities developed in response to substances in the circulation, are doveloped as reactions to afferent nerve impulses, or sensory impressions, which spring for the most part from the cultaneous surface *

The victim of pulmonary tuberculosis, thrilled with sickening chills along his spine, is prove to huddle over a stove in a closed chamber, or

There is an analogy between the action of these trophic afferent impulses and that of the blochemic antigens which stimulate tile tissues to produce immune bodies. Of the suggestive paper by Crite

to seek relief in a land of perpetual summer. But practical clinicians have found that recovery from the infection is apt to be furthered rather in a somewhat variable said rigorous than in an equivable climate, and it is the general testimony from health resorts that patients commonly do better in winter than in sumer. It is sugmificant that the same patient who left to his own devices had dreaded a fall of air temperature below 72° F under proper therapeuthe control learns to rejoice in the crisp freezing air of a northern winter. His point of vice has been so altered by training that his feelings of pleasure and pain resume their normal function as sentinels to conserve his well being. He breaks the vicious circle in which a morbid sensation led to a hurtful act (for the specific indications for the application of the open air treatment in pulmonary tuberculous see Volume II (Chipter XXV).

When the conception obtained currency that the open air was the most salutary environment for the consumptive, a tendency was mani fested by certain phthisiographers to estimate as of equal therapeutic value all open air and to deery the hitherto assumed virtues of climatic change While admitting that the climate of the back yard was more remedial for the tuberculous than the climate of the adjoining kitchen they would not grant that a still greater deviation in meteorologic conditions to be found in distant resorts could have healing virtues in excess of those to be found on a city lot This question can only be decided empirically, but the reason cannot but be impressed with the physiological facts of climate, such, for example as the specific atimulation of the blood forming organa, of tiasue proteid assimilation etc. which occur in mod erately high altitudes. The unbiased mind must grant at least, that every climatic complex operates for or against the recovery of a consump tive in proportion as it excites con ervative or destructive physiological reactiona The impression has Lained ground that a cure of tuberculosis at high altitudes leaves the patient e pecially liable to relipse or to again contract the disease on returning to lower levels. It is probable that the only truth behind this belief is the fact that many cases of arrested pul monary disease can pursue a useful life only under certain favorable con ditions The tendency of persons returning home after achieving arrest of their disease, is to abandon the hygienic methods to which they owed improvement. It is also true that the temperament and constitution of one who has harbored tuberculous of times demand the stimulating conditions of high altitude to maintain a feeling of well being which of itself must be a powerful aid to the resistance powers. The body is probably vastly more sensitive to the influence of environment and is subject to a wider variety of physical stimuli than we have any idea of An experi mental analogy for this position is offered by the exceedingly suggestive results obtained by Reid Hunt in his investigation of the effects of a restricted diet and of various diets upon the resistance of animals recognize the impurity of respired air are not due directly to acquired chemical properties of the air. but to the irritation of certain sensory nerves of the skin brought about by a rise of temperature combined with a high degree of relative humidity. The nerves specifically concerned in these sensations would seem to be those delegated to temperature sen sations, moreover, in the clothed subject, the skin of exposed parts, the head, neck, hands, wrists, possibly the lining of the nasal canal, would seem to be of relatively paramount importance. In explaining the main tenance of a constant body temperature under wide thermal variations of the air, we find no difficulty in ascribing profound alterations in metabolism to stimuli arising in the temperature nerves of the skin. From the same point of view the suggestion is obvious that the sensitions of comfort or discomfort aroused in "good" or "bad' air are but incomplete conscious expressions of tissue reactions which determine the molecular efficiency of the machine, and meidentally regulate the production of substances protective against disease. While heat and humidity are of predeminant importance in the excitement of cutaneous sensations leading to feelings of well being or ill being, it would be a too narrow view which would restrict to the action of these physical agents the multifarious sen sory impulses, largely operating through the consciousness of pleasure and pain, through which the metabolisms of the body are, I believe, largely ordered

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Rheumatoid Diseases —Painful affections of the connective it sues grouped under the term 'rheumatoid disea es" are common in high altitudes their mendance probably bears on inverse proportion to the metabolic reactive power of the individual. On the contrary acute articular rheumatism is le-streauent than at see level.

The writer has hild intimate opportunity of studying the case of a min who in Denvir suffus much from ill-direct puins, at times chrite terized as muscular rheumatism, and heidachts which are relieved by shlevitate of sode. The c. symptoms disappear on a journey to sea level and yman; in abevance for some weeks after his return.

Respiratory Affections —Catarrhal conditions and bronchitis as a rule are most favorably influenced in a climate of moderate humidity Newcomers in Pocky Mountain resorts hibitially complain of irritative

symptoms which are due to drying of the inueous membranes

Twherealous largequits and other organic respiratory affections, though primarily contra indicating dry air not uncommonly in elevated regions and unchoration in the establishment of  $\tau_{general}$  improvement in well being. Theory and experience agree in the techniq that the mortality from lobus pinginomia merica establish altitudes. Nevertheless protitioners in moderately elevated  $\tau_{general}$  altitudes. Nevertheless protitioners in moderately elevated  $\tau_{general}$  and altitudes. Nevertheless protitioners in such as the protition of the prot

Certainly the pneumonia morbidity and mortality in Denver are not

in excess of those for the same disease at sea level

One of the most curious of climed experiences with bronchial arthma is the frequent emplete relief afforded at elevations of a mile or so above set levil. On the contrary the subjects of emphysema are not ant to do well.

Heart Diseases —Heart di ence are benefited or made worse in high altitudes, in proportion to the power of the heart to respond to excessive demands upon it and thus increase its range of accommodation.

The pre-cription of mountain climbin, for dironic heart disease has a sound physiological basis. Nevertheless when a physician at an electrated resort hads it difficult to restor a broken compensation he desires above all things to see his pittent transported to a lower level.

While the body is at r. t the mechanical conditions of the circulation are practically identical through a wide ring of elevation above the sea but the demands of miscribir exitin call for an increase of cardina activity which is excessive in proportion to the altitude. Acclimatization, or training greatly expends the limits through which the heart can adjust itself without overstands.

R H Bahcock is probably correct in his assumption that the condition of mitral stenosis is one which, for mechanical reasons, especially to certain poisons. He found that the resistance of some animals to certain noisons may be increased fortyfold by changes in dict, the con verse effect may follow an appropriate du tars. The resistance of animals to the noison was directly related to certain internal secretions, partien larly that of the thyroid gland, whose production is modified by diet Season has an important effect upon the resistance of animals to certain poisons, in some cases these effects seem to depend iron seasonable varia tions in the activity of the thyroid"

The writer has recently been impressed with the importance of con sidering the gold ilkali balance of the blood as a factor affecting tissue resistance. Where a condition of acidosis exists, as may be manifested by an excess of acctone in the nrine, mysterious disorders may sometimes castly be corrected by the amplication of appropriate alkaline and dietetic There is reason to believe that the backsets to which many tuberculous invalids are prone without apparent cause often find their explanation in a regirring reidous

In an essay like this only general relations of climate to special dis eases can be touched upon. The works of Hungard, Solly, and others

must be consulted for details

Anemia -I flictent operation of the blood forming organs is a funda mental requirement for health. Ande from the specific effect of infections, the state of the blood has a direct relation to elimitic covaranment Residence in the tropus is said to induce anemia, whereas remaral to an invigorating climite restores the blood. The work of /untz, Hildane, and others, on high altitude physiologs, seems to demonstrate that the diminution of oxygen tension in the air specifically stimulates the have marrow, and probably other sites of blood formation, to excessive activity

Therefore, even it moderate illustrous of 3,000 to 7,000 feet the red blood count and the bemo_lobm percentage exceed the c of people at sea level At high altitudes health deminds a proportion ite increase of hemoclobin and red corpuscles. In somewhat crude chineal observations at Denver, one mile above sea level, I have been recustomed to find disorders attributable to anemia in patients whose hemoglobin percentage ranged

as high as from 70 per cent to 85 per cent

Gout - Cour and litherne states are due to conditions of metabolism and circulation which are modified by climatic treatment. According to Huggard, "a dry, bracing climate is always most suitable" Nevertheless, the writer is convinced that a characteristic effect of residence in high altitudes, at least in the musiclimited, is a relative venous plethora High venous blood pressure, recording to good authority leads to goit Newcomers in inoderately high altitudes particularly if indiscreet in exercise, are apt to suffer from "bilions attacks" as a phise in acclima tization

Rheumatoid Diseases —Punful affections of the connective tissues grouped under the term rheumatoid diseases' are common in high altitudes, their incidence probably leiks in inverse proportion to the metabolic reactive power of the individual. On the contrary, acute articular rheumation is less frequent than it as level.

The writer his hid intimate opportunity of studying the east of a man who in Dunier sufficis much from ill defined pains at times characterized as muscular rheumitism, and heidaches which are relieved by sibellate of soft. The e symptoms di appear on a journey to sea level and remain in abeviace for some weeks after his return.

Respiratory Affections—Columbial conditions and bronchitis as a rule, are most favorably influenced in a climate of moderate humidity beauconers in Pocky Mountain resorts habitually complain of irritative symptoms which are due to drying of the mucous membranes

Îuberculous largaquite and other organic respiratory affections, though primarily contra indicting dry un not uncommonly in elevated regions had ameliorition in the establishment of a general improvement in well being. Theory and experience agree in the teaching that the morthlite from lobus pieumona increases in high slittindes. Neutribless, practitioners in moderately elevated regions will agree with J. N. Hall with from a wide experience concludes. I believe from this study that the mortality of scritt pneumona is not meterally affected by altitude until one prises beyond an elevation of 6000 or 7000 free?

Certainly the pneumenia morbidity and mortality in Denver are not

in excess of those for the same disea e at sea level

One of the most curious of clunical experiences with bronchial

asthma is the frequent complete relief alforded at elevations of a mile
or so above sea level. On the contrary, the subjects of emphasema are

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Heart Diseases —Heart disea es are lenehted or made worse in high
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demands upon it and thus increa e its range of accommodation

The prescription of mountain climbing for chronic heart disease has a sound physiological basis. Nevertheless when a physician at in clearated record finds it difficult to restore a broken compensation, he desires above all things to technications.

While the body is at rest, the mechanical conditions of the circulation are practically identical through a wide ring of elevation above the sea, but the demands of nuevallar vertical cell for an increase of cardiac activity which is execusive in proportion to the altitude. Acclimatization or training, greatly expands the limits through which the heart can adjust it off without overstrain.

R H Bibcock is probably correct in his assumption that the condition of mitral stenosis is one which, for mechanical reasons especially 206

contra indicates high altitudes. Nevertheless, in Denver, for example, many persons with stenosis of the mitral value live in comfort. Nerious affections of the heart appear to be bettered or otherwise, in high altitudes, according to the general reactive powers of the nations.

There seems no reason for believing that, in patients who lead a quiet l fe, arteriosclerosis contra indicates residence in high altitudes. However, it appears that ancurism and mortality therefrom are considerably

greater at high than at low elevations

Disorders of Digestion —In the writer's estimation, chimate is indirectly of importance in its impress on the digestive functions through its effect on the metabolic and nervous systems

Lspecially in high altitudes, a "nervois dyspepsia" is apt to reflect imperfect adjustment to the environment, and a 'bihous attack," which the writer has attributed to relative venous engograment, frequently at

tends the process of acclimatization.

Skin Diseases — Great importance has been attributed in the foregoing pages to the physiological functions of the skin. There is no organ of the body which comes so directly under the influence of climato as the skin, jet there appears to be but a meager collection of data regarding the subject, either in health or discase. Cases of eccema at least in its acute form are said to do badly on the seasiors, and in cold, damp weather. Acre is also made worse on the coast, and is apt to improve in dry inland stations. Cases with portages do better in a warm climate

It has been said that at high altitudes those cases do worse in which

the skin disease depends on nervous derangement

Disorders of the Kidneys—It is generally admitted that the chief object to be secured in the treatment of kidney disease is rest for the organ. The potent factors within our control include diet, muscular exercise and the activities of the skin and lungs. Experience indicates that patients with disordered kidneys fare worst in cold, damp places of variable temperature. They thrive best in warm, equable, and somewhat dry climates. There is substantial basis for the opinion that persons with inflamed or de-generated kidneys are apt to fare badly at high altitudes. In my experience disease contracted at an elevation is better borne than when imported. It is difficult to accludate a diseased kidney.

The observer is impressed with the importance of the circulation in renal insufficiency. Chinical experience has impressed me with the belief that passive congestion of the kidneys is the preponderant deleterious factor due to the conditions of high altitude. Certain forms and stages of kidney disease as of heart disease, are distinctly ameliorated by a undersous mode of life at a moderately high altitude.

The Nervous System —Special emphasis has been laid in the preceding pages on the purely psychic value of climatic change. The mental state is molded to a great degree by the reactions occurring in the various organs, among which the nervous system is of predominant importance. Climates may affect the nervous system either directly or indirectly through their influence on metabolism in its widest sense. Using the rather indefinite terms in vogue climates may be relaxing scidatic or stimulating in their influence. When nutrition is improved and a state of well being secured, the qualifying term tonic may be added. Thus, warm most consts or islands are sed titve to relaxing. On occur voyages or cooler coasts the prevailing influence is bounesefative. Influed places of low altitudes are usually simply tonic in effect. Elevated inland regions are stimulating tome or simply stamplating."

It has been made obvious that the physiological influence of high altitudes tends to increase the chemical activity of certain vital tissues of moderate elevations, 4,000 to 6 000 feet lying on of proteid tissue, building up of the organs, and improvement in their efficiency tend to occur. With further increase of elevation katabolic processes gain ascendancy and it is as if the machine suffered from internal friction. It cannot be too strongly emphasized that physiological adjustment to lowered harometric pressure requires time and rest. Imprudence in everouse on the part of newcomers is prone to turn a sojourn which might have been salutary into a period of nervous overstrain. Constitution and temperament determine to an extraordinary degree the fitness of people for residence in elevated regions. Persons of phlegmatic disposition or those who are nervous from malnutrition or overwork are spit to do well at high situides. The hysterical and those with inherent nervous temparaments often find their disorders accentuated. Nevertheless the medical observer is often astomished at the development of nervous stability in patients whom from a theoretical viewpoint he would have advised against seeking a high altitude. The general beheff that an occasional drop to sea level is necessary to the best interests of resultents at high altitudes is probably well founded. Differences in temperament and constitution which be come especially conspicuous under the strain of low atmospheric pressure no doubt determine in a less sensible degree the adaptability of people to other clusters conditions.

Thoug, he may not accept fully Major Woodruff's dictum that in the tropics or brilliant sunlight fair shanned persons always deteriorate in kealth, as compared with brunches it is neverthelees true that individual as well as racial characters determine to a degree the adaptability of climates to the preservation of health and the cure of disease

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#### CHAPTER V

### PHYSIOTHERAPY MASSACE EXERCISE

HARRY EATON STEWART

#### PHYSIOTHERAPY

Before considering in ditail the different phases of physiotherapy and the proper method of blending them in the treatment of various discases and injuries a brief survey of the subject its scope and relationship to general medicine and surgical practice is in order Physical agents have been employed therapentically since the earliest days of medicine exercise massage, sunli, lit and water applied to the body were the first physical a ents to be used Galvanie and faradic electricity have been used for about a century Static electricity has been employed nearly half as lon, while the sinusoidal and high frequency currents are of recent date. The amuzing speed attained in the recent development of sci entific medicine has been more than matched in the field of physiotherapy by the development of modern apparatus experimentation and refine ments in technic. The advance in the scientific application of physical therapeutics in the last decade is perhaps greater than that which was made up to that time The pioneers who worked in the field of electrotherapy, hydrotherapy or massage and exercise laid the foundation for the modern use of physiotherapy forming the basis for the millions of treat ments given to the exservice men. In the medical corps of the various armies during the Great War for the first time in the history of medicine a large number of regularly trained physicians devoted their entire time and attention to all branches of physiotheraps

In the American arms, we were able to institute a department of physiotherapy which functioned in rivivino different hospitals and was comprised of over a hundred physicians and twelve hundred reconstruction aides. The personal breking of the Surgeon General and the organ leation of a department of his office under I reutenant Colonel Frank B Grauger of Boston brought to ether a personnel and equipment the like of which had never before custed. From 1918 to the end of 1922 milhons of physiotherapy treatments were given to the service and ex-

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service men by the medical departments of the Army, Navy, U.S. Public Health Service and Veterans' Bureau. The results on the whole were extremely gratifying and by reason of the vist amount of data collected we may feel that physiotherapy is on as firm and proved a scientific brisis as any other branch of medical practice.

The scope for the application of this branch of therapy has rapidly widened until at the present time 1 large proportion of diseases and almost all types of injury are amenable to treatment by it. It cannot be too strongly invisted upon that with a few minor exceptions physiotherapy



FIG. 1-A WELL EQUIPPED ELECTROTHERAPY POOM

is not a complete regime of treatment but is an adjunct to the routine hygienic medical and surgical care of the patient. Fortunately there are practically no contra indications to the employment of the accepted methods in combination with physiotherapy in any given case. Long retention of fixation applications is perhaps the main exception. Phonoreterapy is directly applied to the infected pirt. It requires a large amount of detail in the technic of its employment. The large floor space and special apparatus required to do the best work places a limitation upon the amount of play softerapy which the general practitioner can do conveniently. Nevertheless, it is vitally important that he be able to determine those conditions in which the help of physiotherapy will lead to more rapid recovery on the part of his patients. A full equipment is

for the specialist and the be pital department of phisiotherapy, both of which are now rapidly increasin, in number. On the other hand, a great deal of good may be accomplished with a comparatisely simple equipment providing the indications and principles underlying, the technic net throughly understood. From a good piece of spirating and the manufacturers direction as to its use are not a sufficient background for practice in even a single branch of physiotherapy.

A digest of the main modalities is ed and indications for the employment of physiotherapy will evemplify the widening scope of this brinch of treatment. The electrical entrents are employed in accordance with their three main effects on living it size first, changes in chemistry see ond, mechanical action and third the production of heat. In this first division falls the straight goltome current and we is on to to rearrange the ions within the tissues to drive in drug ions from without, to destroy tissue in their causive concentration and to allay here pain. In the second group are found the interrupted and wave goltomic indisinuously currents weld for the construction of muscle completely or partially deprived of its nerve supply, and to stimulate other functions by muscular contrictions.

Faralism is used to restore the tone of underfunctioning muscles whose nerve supply is normal. Static electricity in the form of the Morton wave sparks and efflure is employed to produce mive or local tissue contraction for glundular stimulation or the removal of lumphino stass, and to allegate point due to the pressure of such stans. The high frequency currents of Oudin and Tesla produce superficial and to a certain degree deep least rehero pain and stimulate metabolism or destroy by fulguration when localized at a needle point. Diethermy which is one of the most powerful agents in all the field of medicine creates an in the next powerful agents in all the field of medicine creates an intended of the produced of the state of the supplies of the supplies and the resistance to localized infection. Its general effect in lowering hypertunion decreasing pain and promoting, general and local metabolism as also made use of

I advant light and heat stumulate the circulation relieve pun and

promote repair

Ultraviolet light has both a local and general effect. Locally at is one of the finist-powerful of antisophers with neeffect upon the host other than the destruction in strong doses of superfaceal epithchium. Most localized infections yield readily it is suppliestion in their carly stages. In moderate amounts it is a very powerful stimulant to skin cell growth and its indicated in slowly licaling, wounds and ulters of the kin. Generally, it is the same, tome to the bods that smight is cirriching the hemoglobin and the fighting property of the blood phereasing metabolism and indicating sleep.

Exercise and mas age develop the body and its nervous coordinations,

stimulate metabolism, defer tissue deterioration in middle life, aid cir cultion and help to present and reduce deformity

Hydrotherapy may be used to induce reflects both stimulation and sedation of the nervous system and obtain both local and general changes

in the circulation

The time when the term physiotherapy meant "bakin, and message" is over, so is the real usefulness of an assistant whose methods are limited to these two means

# REQUIREMENTS FOR HOSPITAL AND CLINICAL DEPARTMENTS OF PHYSIOTHERALS

The government hospital department of physiotherapy has served as a model for a number of such departments recently established in civilian general hospitals

Personnel—The type of young woman who became the reconstruction add of the war and post wir days had, as a rule, normal school, college or nursing training and received intensive courses in all branches of physical therapy. There are several schools of physiotherapy graduating well trained aides and they are becoming available in increasing numbers. There should be one aide for each four to eight nurses, depending on the type of eves handled.

Floor Space—A great deal of work can be done in a relatively small space if it is properly arranged. There should be many wall plugs, divided into several separate circuits. The intake wiring and fines should be very heavy. If the tables (or embeles) are arranged parallel, with four feet between them and the side wall, much of the apparatus may be conveniently shifted to the various tables or stells. All circuits should be numbered in the fuse boxes to facilitate quiel replacement of fuses when blown out.

Apparatus—A small depirtment for a bospital of one hundred bels would require at least the following apparatus—eight treatment tables, two sets of pulley weights one gilvame control, one faradic coil, one sinusoidal machine, one air-cooled ultraviolet lamp with a few quartic applicators for local work, four small portable or two 1500 cuidle power radiant lights two portable and two stationary high frequence machines. In a two hundred bed hospital, this equipment should be doubled except that a water cooled ultraviolet lamp instead of a second air-cooled should be added, together with a motor vibritor, static machine and paraffin bith Care should be taken to state the type of entrent, frequency and voltage in ordering machines. In larger hospitals and those devoted to special types of cases, this equipment would have to be greatly modified. A corrective gymnastic room and hydrotherapy plant are most useful where it is possible to install them.

Post war Reconstruction -The writer after his work as assistant director of physiotherapy of the army section, organized the section of physiotherapy in the Bure in of the United States Public Health Service which took over the care of the disabled ex service men This work has grown during the last four years to a magnitude equaling that done by the Army Medical Corps and has now been transferred to the Veterans Bureau In the meantime the Public Health Service has continued and extended this work among its own Warine Hospitals, and the Navy has also established this branch of its medical service on a good hasis. The longer these hospital departments have functioned the more invaluable have they proved themselves With the exservice men the work, now largely with chronic diseases has fallen into three main types. First the neuropsychiatric cases which include peripheral nerve regineration traumatio psychoses of various types and a wide variety of other con ditions All types of physiotherapy are employed in the treatment, but bydrotherapy takes a more prominent place than it does in the general hospital Second the inberculous group often complicated by war wounds and various other conditions With this class of cases, ultraviolet light is of great importance although all methods are employed. The third type is the general medical sud surgical group which requires a well rounded application of physiotherap. It is certain from the rusults obtained that physiotherap, will have an increasing role in the treat ment of these conditions until the chapter is closed. Those in charge of ment of these conditions than the chalper is closed. Those in charge of departments in general and special hospitals can learn much from what has been accomplished by the adequate thorough and persistent application of physiotherapy to a wide range of conditions under government super-

Industrial Academis — There have lately been established in rapidly increasing numbers clinics and hospitals devoted entirely to the physical reliabilitation of the injured workman. Physiotherapy and presembed occupational theory with vocational trining form the backbone of their work. It is a matter of great economic importance to the worker his family, his employer and the compensation insurance companies that he be returned to functional efficiency and full earning power at the carliest possible moment. Once the initial surgical care has been properly per formed main dependence for this errly return of function must be placed on physiotherapy. Nothing else can be substituted for it. The recovers time in fractures can be reduced by whont one-third. In cases of sprains and bruises an even greater reduction in recovers time is possible. The cost of special treatment or of maintaining a department of play wotherapy is much less from an economic standpoint alone thus is the payment of compensation through an unnecessarily long period of disability. There is no question that in this particular field physiotherapy will make one of it is most valuable contributions to medicine.

Athletic Injuries —It has been conclusively demonstrated in the treat ment of the injuried athletes of some of the larger university terms during, the last three years that physiotherapy properly used greatly ents does the time of disthlitty during which athletes have lost their usefulness to the term. The sprains, strains and muscle bruses which make up a larger part of athletic injuries are especially amenable to physiotherapeute treatment. The danger of permanent distability or recurrent injury through chronic weakness is markedly less ened. The presenting of the treatment must be in the hands of the term physician and not the athletic trainer.

General Hospital Practice—It has been stud that "no hospital carell itself modern in these data unless it has a good department of physical therapy. That stitement is sub critical to by pretically all physicals and surgions who have had the opportunit to watch such a department function. Occasionally, in the government services, the incident officer in charge of a hospital has been reductant to assign the space and under the the expenses incident to the establishment of a hospital department. Practically without exception those incideal officers have become enthusiastic in their support of their physiotherapy department. They have come to the conclusion that the average number of hospital data his beat sufficiently reduced in the case of patients treated by physiotherapy to more than companies for the expense and the space necessitated by its installation.

Medical School Gurriculum—Only a few of our medical schools have as vet placed physiotheripy in the course of study. A reviewer of the Journal of the American Medical Issociation in a recent comment on a new text on this subject street, "The subjects are generally studied in adequated or not at all in moderal schools. One of the excuses given for the neglect of these important topies in the medical school has been the lack of a smithle textbook. Unfortunately the real cause for the neglect of physiotherapy is the ignorance of the framers of medical school curriculums regarding at As the studiuts of the present become the curriculum makers of the future we have here a vicious series.

There are many well qualified terebers now available and there is no longer adequate excuse for the neglect which the medical schools have shown in instructing their students in this unportant subject

The object of the section termed Applied Physiotherapy (Chipter XII) is to show the proper blending of the verious modalities described in Chipters V to XI in the treatment of those phases of injury and disease in which these measures have proved of value. Very little has appeared so far in the literature on the use of more than a single type of physiotherapy in a given condition. The author of a textbook on Hydrotherapy trains of the physical order to the supplication of thirt phase alone and gives an appended list of pathological conditions in which it is useful. The same

is true of authors of texts on French and Massage or upon Electrotherapy it is felt that an outline of the properly combined u of the different types of phisotherapy indented in any stree condition will prove of great value. It must be thoroughly understood that the writer is dealing with physiotherapy as an adjunct to the indicated hygienic medical or surgical procedures in every given was and it is taken for granted that these measures have been determined upon and instituted in conjunction with the phisoid therapeutic measures here outlined. In the more common conditions met with in ideal treatment prisuppo ing the use of a complete equipment will be considered and where possible a simplified technic will be added which requires but that appearing.

Through choice, a large number of conditions in which types of physiothertyp, have been used but where the results larve not been uniformly of value, have been omitted. Success in using physiotherapy is dependent as much upon a thorough detailed knowledge of the proper technic as it is in any other phase of therapy. The work, and research now being done in the field will undombtedly rapidly widen the known indication for its use. The physical and surge in now have at hand an adjunct of in creasing usefulne is in the field of they pentice, and one which will righly

repay them for time spent in careful investigation.

## MASSAGE

Definition—Us sage is the securitic manipulation of the off it sues of the living body for their peutic purposes. It modifies both the physiological and pathological to sue pricesses by mechanical means

History - Many centuries before the Christian era the Chine e mire

probably the first to use massing. In Index Japan and Arabin the use of this method of treatments were old. It was used for therapeutic purposes by the Greeks and testimons as to its value in certain conditions can be found in the writings of Hippocrates. The Pomans employed massings in connection with their baths. Galea used it with the gladuators in preparing them for exhabit.

Pire in the sixteenth century recommended massage and passave motion in dividied joints and miny other conditions. A little over a century ago the French extended its use and give their terms to the various movements into which the menipulation became divided. To Grocesnot of Finglind Balfour of Scotland and Fingly, of Sweden we one the placing of massage upon a scientific biass. Pirtucularly are we indebted to Fingling the second of the proper correlation of exerct court massage. During the First hilf of the nucleonth entury. Merger of Austerdam Weir Mitchell and J. If Aellog, of Churries were instrumental in gruing the recognition of the

profession to the value of massage, until at present the wide therapeutic indications for massage have general recognition

The widening stope of other phases of physical therapenties his clearly demonstrated the fact that there are other and better means of infalling some of the indications for which missign has been formed used. However, for cirtum results no substitute will sarre as well

In modern therapentus, mas ago is usually blended with other types of physiotherapy and takes an important place in such combinations of treatments



tic . - FFEFERACE OF THE LORLARM (Courted) Laul B Hoeber )

General Considerations—The physician with his background of anatomy, physiology and pythology my acquire sufficient knowledge to prescrib massing incling mly in a very short time. The amount of practice neces are for him actually to give a treatment with reisonable skill is not great. While few physicians are able personally to do their trial ment work, the knowledge acquired in learning how to do it well will be invaluable in estimating how skillfully their prescriptions are carried out. The rubbing of the Furkish bith attendant and the manipulations of the athlicite term rubbing of the Arrivel hiller faction to scientific interesting, nor is the efficiency of the average treatment in direct proportion to the amount of physical energy that the masseur expends, upon the patient.

There are three distinct schools of massage, the Fughsh, Swedish and

Hoffa The best work is done by those whose knowledge of anatomy, physiology and pathology is greatest and who have made a careful study of all methods, blending the best of each and evolving their own per sonal technic It is well to watch carefully one who claims to be pro-ficient in any one of these schools The attitude of the masseure should be sympathetic and friendly, yet detached and husinesslike for it is only through absolute confidence on the part of the patient that he is able to relax completely and best results be obtuined. No jewelry should be worn on the hands of the operator, nor any sleeves below the elbow Only the part of the patient's body under treatment should be exposed The part being massaged should be supported. The temperature of the rooms should be from 70° to 75. F. Where much massage is to be done it is necessary to have an especially constructed table which should be about 2 feet wide and 32 to 30 inches high. A solid table covered with a good mattress is to be preferred to springs of any kind. In our army the reconstruction aides very often discovered during their massage the presence of foreign bodies and changes in the condition of the parts These here they were encouraged to report to the plusician, but changes in technic of treatment were not and should not be allowed without the physician s orders It must be remembered that we are dealin, with a potent agency when we are applying massign to patients. The physician's when we are applying massign to patients. The physicians should no more order massign for a given condition without stating the type and the amount than he should order drugs without stating the kind and the dosage Massage may be used for diametrically opposite purposes to soothe or to stimulate, and must, therefore be minutely prescribed if the treatment is to be beneficial

Most mas-eurs use some kand of a lubricant on the bands. Cold cream concea butter, vaselin and olive oil have all been used for this purpose. The first is perhaps the bet for general use and should be removed from the kin with slechol. There is a general tendancy to use too much lubrication. It is impossible to produce good friction with any lubricant. Powder is being used more extensively and is preferred by many. The use of stimulating himments or ictibyol in any form for counterprintation is of no use to the patient, and it may seriously affect the hands of the operator

The length of time of a treatment depends on many factors. A local treatment of from five to ten minutes is sufficient as a rule when combined with other phriscal agests. In the treatment of a single part where missage alone is used fiften to twinty minutes may be employed. In a general treatment, which should take about an hour the relative number of minutes given each part abould be approximately as follows lees fiften, arms, ten clest five abdomen fifteen Such gen end treatments should be given not some thru an hour after cating and a short period of rest following the truatment is advasable. The severity

profession to the value of missige, until at present the wide therapeutic indications for massage have general recognition

The widening scope of other phases of physical therapeutics has clearly demonstrated the fact that there are other and better means of fulfilling some of the indications for which massage has been formerly used However, for certain results no substitute will serve as well

In modern therapeuties, mas age is usually blended with other types of physiotherapy and takes an important place in such combinations of treatments



FIG .- LIFLEURAGE OF THE FOREARM (Courtesy Paul B Hoeber)

General Considerations -The physician with his background of anatomy, physiology and pathology may acquire sufficient knowledge to prescribe my sage intelligently in a very short time. The amount of practice necessary for him actually to give a treatment with reasonable skill is not great. While few physicians are able personally to do their treat ment work the knowledge acquired in learning how to do it well will be invaluable in estimating how shillfully their prescriptions are carried out. The rubbing of the Turkish bath attendant and the manipulations of the athletic team "rubber' have very little relation to scientific massage, nor is the efficiency of the average treatment in direct proportion to the amount of physical energy that the masseur expends, upon the patient

There are three distinct schools of massage, the English, Swedish and

in the direction of the venous or lymphatic flow. It is done lightly for superheal effect more deeply to affect the circulation of underlying its use. Where possible the hand or fingers are kept in contact with the part returning very lightly to the striking point of the stroke. The pressure is insuffly slightly greater in the mid part of the stroke. The pressure is insuffly slightly greater in the mid part of the stroke than at twenty to thirty strokes per minute on the viczige. It is a general rule for the movement to be extrict beyond the vest provimal joint. It is of great importance to train the hands to equal skill so that they may be used alternately or simultaneously with the same defit touch. In full limid stroking the fincers should be hald hightly together.

The physiological effects of efficiency are perfectly definite. In light visitoning the senativity of cutineous nerve endings is lessened there is a slight dumination in the skin circulation and diminished activity of the skin glands. In deeper stroking the edative effect is not as mirked. There is a shirt increase of the skin circulation and activity of its clauds and a marked effect on the returning circulation in the vens and lymphites. This aids in the rimoval of extra used blood and lymph, and

necumulated futigue products

Petrissage (ninching or kneeding) is perhaps the mo t valuable move ment of massage and hould therefore be thoroughly ma tered Like offlenrage the operator was a portion of the hand comparable to the size of the tissues to be knewled. On the mu cles of the hands and face the tips of the thumbs and first and second fingers are u ed for picking up rolling and twisting the finer muscles. In working on a single finger or toe use the tip of the thumb and hast finger of one hand one placed laterally, the other anteroposteriorly. In muscle groups the size of the c in the arm the grasping is done with the entire surface of the ingers and thumbs mainly by flexion of meticarpophilanged joints. In graspin, larger muscle masses the entire surface of both hands is used purilled and the muscle fibers grasped transversely. In many regions particularly on the back the muscles are rolled and kneaded against the bone. In the arm and lower leg the muscle groups are grasped between the thumb and fingers starting distally with alternate prisping and relaxing and working in a proximal direction. Skillful operators often develop a slight twisting mosement with the bands which is an uil in thorough kneading. On the abdomen where we are unable to pick out the various muscle layers the kneading is done in concentric circles deeply enough to reach lower muscle layers. In the late d region there is considerable den a fascia and the kine iding hould be deep enough to reach the muscle groups

The physiological effect of petrissign i to stimulate both motor and sen son norre endings increasing, in cle tone in proportion to the vigor of the treatment within reasonable limits of time. Latigue and tone prod

of the treatment and the relative proportion of time given to the different types of manipulation are determined by the object in mind

Types of Movements—There are five main movements used in massage

- 1 Effleurage or stroking
- 2 Petrissage (pinehing or kneuding)



1 io 3 - I etrispace of Call Muscle (Courtesy Paul B Hoeber)

- I ipotement (hacking, slapping or percussion)
- 4 Triction
- 5 Vibration

Effleurage or stroking may be done by the entire palmar surface of both hands, used simultaneously or afternately. In stroking medium sized surfaces such as the arm or the lower leg the fingers and miner surface of the thumbs are used with a firm but flevible grasp which recommodates itself to changes in the contour of the part. In still smuller surfaces like the Achilles' tendon, the thumb and first fauer only may be used. Be tween the interescent on the back of the hand, the tips of three fingers, or the tips of the thumbs are used also in both strught and spiral stroking of the fingers or toes. All stroking is done slowly and with the exception of the special technic for imputation stumps, later to be described,

in the direction of the venous or lymphatic flow. It is done highly for superficial effect more deeply to affect the circulation of underlying its us. Where possible the hand or fingers are kept in contact with the part, returning very highly to the starting point of the stroke. The pressure is usually slightly grater in the mid part of the stroke than at the beginning and end of it. Effleurings should be slowly done perhaps twenty to thirty strokes per minute on the iverage. It is a general rule for the novement to be carried beyond the lext powerful joint. It is of grat importance to train the hynds to equal skill so that they may be used alternately or simultaneou by with the same defit touch. In full hand stroking the fingers should be held helptly together.

The physiological effects of efficacy are perfectly definite. In high the strong the sensitivity of entiments nerve endings is less uned, there is a slight dimmintion in the shin crealition and dimmished activity of the skin glands. In deeper stroking the sedative effect is not as marked There is a slicit inviews of the skin enrelition and entitivity of it glands and a marked effect on the returning circulation in the vens and limitation and extra side in the returning circulation in the vens and limitation.

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The physiological effect of petris age is to stimulate both motor and sensory nerve endings increasing muscle tone in proportion to the vigor of the treatment within reasonable limits of time. Fatigue and toxic prod

ucts are mechanically removed, together with extravasted blood and lymph The capillary circulation is made both more rapid and greater in volume and the venous and lymphatic circulation markedly quickened. This procedure is contra indicated in conditions of muscular hypertension and spasticity, and should be done lightly with a minimum length of time in muscles having a deficient motor innervation. This stimulating effect on the general metabolism of muscle tissue is similar to, but not as ef ficient as, that obtained by active exercise. It can be used as a substitute for such exercise where muscle contraction would displace the fragments of fractures or bring strain on torn ligaments

Tapotement includes slapping cupping, backing and percussion

Shipping should be performed with the palmar surface of the fingers. by quick, light, alternate strokes, wrist relaxed, and the fingers or whole hands immediately rebounding from the skin surface. At no time should the stroke be heavy or the hand remain upon the skin. By this technic the sensory nervo endings are acutely stimulated, the superficial cipil laries widely dilated, and there is a reflex general stimulation produced on the entire nervous system

Cupping is done by the hands, with fingers and thumbs held tightly adducted and with a slight flexion at the metacarpophalangeal joints Tho blow is somewhat heavier and while not remaining on the skin, it has not the instantaneous rebound of proper slapping. The effect of cupping is somewhat more intense and deep seited than that of slapping, but accomplishes much the same results

Hacking may be given lightly or very beavily, depending upon the manner in which the hands are held, and the vigor of the blow. In both types, blows are struck with ulner side of the hand, and little finger The movement is performed by rapid alternating adduction of the wrist joints, coupled with slight supination of the forearms. In light hacking, the fingers are relaxed and allabily separated and strike the body, the little finger first and the others in succession. The blows alternate with extreme rapidity and with a rebounding character, resembling that de seribed for slapping This movement is easier to acquire if the elbows are semiflexed and held somewhat out from the body. It is one of the most difficult movements in which to obtain skill and necessitates con siderable practice. In heavy backing the fingers are held in adduction and rigid, the wrist more rigid, the blows given more heavily and slowly The therapeutic indications for the employment of hacking are the relief of muscle spasm of local toxic or traumatic origin, especially in the chronic stage, the breaking up of organized exudates within the tissues, the umrous stimulation of the circulation in large and deep-lying muscle masses, with consequent stimulation of the metabolic changes within them

Another method of hacking, sometimes termed beating, may be em ployed in dense tissues, such as the gluteal region In this type, the fists are tightly elenched and the body hit with the dorsal surface of the second phalangs of the fingers, by a combination of extension of the elbow and flevion of the wrist. The physiological effect would be the same as that of heavy backing

Percussion may be done lightly by straking the back of the index finger, dietal joint, with the index finger of the right hand in exactly the same way that it is employed in physical diagnosis. For heavier effect the finger or fingers of one hand may be struck by the ulnar side of the elenched fist. A hight slow hythinic percussion is soothing in its effect upon nerves lying within the area reached, and conversely heavier percussion is stimulating to them. To a certain extent the viscins supplied by spinal nerves may be effected by percussion along the spine in the region from which they are unservated. A similar effect may be secured at the point where perpineral nerves exit through certain formina.

Friction is given by the use of the tips of the fingers and thumbs or the thumbs alone, placing them on the skin and moving the skin over the subcutaneous tissue, with varying degrees of pressure The movements are nearly always circular in type and as before stated no lubricant should be used, for this causes the fingers to slip on the skin and makes good fric tion impossible. In small areas, such as the hands and wrist, the thumbs and finers may be used simultaneously with opposed grasp while on large flat surfaces it is more convenient to us the thumbs with their pulps describing opposite small circles On small joints such as those of the phalanges, the thumb and one finger of both hands may be used aimil taneously When a sufficient number of frictions that is six to twelve are performed on an area the fingers or thumbs are raised and placed in a new position and the procedure repeated until the entire area to be affected has been covered. The indications for the use of frictions are to break down adhesions, soften scar tissue remove extravasated ma terial from around joints and tendons and to reduce soft evulerant callus In moderately large swellings the movement should be first around the periphery and then toward the center

I thration is accomplished as a rule by the application of one or more finger tips to the skin, although the palm of the hand or a portion of the elenched fix may also be used. A rapid tremor is effected by the action of the muscles of the entire arm to the shoulds joint. The effects produced resemble those of percussion and are used for practically the same purposes. Prolonged light vibration will effect a numbing of a superficial enterwe hulle powerful deep vibration will stimulate. The direct stimula tion of the abdominal viscors is possible by applying this method to the abdomen.

General Lifects—The detailed descriptions of the various movements given above should enable the physician to combine certain of them for his desired therapeutic result. General Indications—Wassing in some form is indicated in most inflammatory process in their subscute or climate the origin, thus a usual, in the local removal of effete material from the tissues.

In atrophic muscle conditions, from whatever cause

To mere use metabolism both general and local To stumulate the activity of the skin, lands

To reduce the amount of scar tissue and callus

To mere ic the lymphatic and venous circulation

For sedative effect on the sensory nerves, and consequent promotion of sleep

To recertain and aid in the removal of forcign bodies, such as fine hramed shot or small pieces of necrotic bone in chronic cases

Contra indications — Unignant to sue or swellings which might by any clother is indignant, should never by missaged until a definite dug nosis is made. Activer should massage be given in the following conditions

Acute influenators proces es

Acute skin infectious

Yeute di ca e accompanied by fever

Acute phil bitis and thrombosis

I ymph maitis of local acute milluminatory combitions
Ostromychius, gustric or duodenil illegra and marked digrees of herma

# GINELAL MASSAGE-LEGIONAL FECUNIO

In a general body treatment the proportionate time given the various parts of the body has already been stated and as simply added for a complete the atment. There running to be given the manner in which the various movements are blended in a thorough massing of the different regions of the body. It is enstorming for many masseurs to mee passive movements in connection with missage. The e-joint moviments are given, as a rule just before the final stroking, the distill joints first, and in each case, if possible the joint is moved through its entire normal rungs of motion several times.

Pressive motion belongs properly to the snoject of exercite, and is described more fully in that chapter. Facial and head massage as not included in the routine general tryatment.

The Arm—Many operators be an on the ungers and hand with all the indicated movements, and work centrally. Some have felt that it is more advisable to work first on the proximal, then on the undille and lastly on the distal many segment of the limb, movements in each region by an directed cutrilly. In this manner the bymphatic and venous circulvions are depleted by natural stages. This same effect may be obtained by preliminary deep stroking. The stroking is carried from just blow the ellow to over the shoulder eap using opposite grasp of the anterior and posterior muscles, with moderately firm pressure. The forearm is manipulated in much the same way the strokes running from just below the wrist joint to slightly beyond the elbow. Sax or eight repetitions of fairly long deep slow strokes are sufficient to accomplish this result. We must then study as as small with the finger.

The fingers and thumbs are worked on rapulls, covering their entire surface about twice with alternate purching triting auteroposteriors and literalls, followed by spring the tips of the fin_trs and thumbs. The themat and bypothenar eminences are petrissaged and frictioned followed by finger tip stroking between the intero set on the back of the hand. The wrist is then frictioned interiority and posteriorly. The fin_ers and thumbs we next rapidly flexed and extended passacels several times followed by curvanduction of the thumb, after which the wrist is more through its full range of motion.

Petrissage of the forearm is given by opposite group with ascending curnular line ding the right hand slightly sheed of the left, and carried to the muscle origins beyond the ellow young If preferred one hand can be used vlone, the other supporting, the pitrent's hand. Tapotement may be lightly given, but is usually counted up muscle groups as small as those in the forearm and arm. A few slow deep effecting movements complete the work on the fore time. With the ellow seemificed the joint is worked on with finger tip friction both auteriorly and posteriorly, followed by passive microns of flexion extension pronation and supination of the forearm.

Petrussage of the arm is directed first upon the anterior and then upon the posterior missles, with the right hand about or the hinds used partille to each other. The exten ors of the elbox are best retthed by flewing the patients arm across his closet. This is followed by slow deep of fleurige, carried over the shoulder and frections centrally covering the shoulder joint. A number of long rapid bight strokes from wrist to shoulder complete the massign.

The Leg - 1 few also deep strakes of th thigh leg and foot in order, are first given. Then the toes are straked angly or together. Thinmb friction and finger straking is done over the dorsam of the foot the outer border and very thoroughly over the arch. The petri age and strekin, of the lower leg is aimed at pickin, out the tibribis antimis probes and calf muscle group and must be deeply and well done to reach the deeper lung and heavier posterior muscles. Plassive motion of the toes foot ankle and kine are given followed by full hand petri suge and deep streking of the mu cles of the third. Long also stroking from foot to thigh completes the treament. Tap tement mus be nick over the calf

muscle group, in both too anterior and posterior thigh muscles, with careful friction over the knee in the popliteal space

The Abdomen — The general object of abdominal massage is to stimulate peristals is and the movement of the intestinal contents, to stimulate the activity of abdominal glands, to stimulate the muscles of the abdominal wall. The patient should be aupine and have the knees mised and supported to acquire proper relaxation. When, there is tenderies in the region of the gall bladder or appendix and during menstruation and pregnancy, abdominal massage is contra indicated.

The palmar surface of the hand is held addicted and hyperectioned and all kneeding, is done in a circular manner. One hand may be used alone, or for deeper effect the other hand placed directly on it, increasing the applied pressure. It is common to start in the region of the eccum performing two or three deep kneeding movements, then replace the hand in a slightly higher position, repeating is following the course of the colon. To reach a proportion of the small intestina, circular kneeding is extended in concentro circles until the entire abdominal will is covered (certile, springer, alternate pressure and rel various over the liver, and abdominal viscera is used for direct stimulation. For the removal of flatulence the whole hand may be vigorously percussed with the palm of the other hand or the elechede fist over the hepotic and splenic fixingers of the colon, and over the storach. Gentle stroking with the hinds spre d, starting high on the flanks and converging toward the group, is used in completting the treatment.

The Chest — Place the thumbs at either side of the sternum and kneed and friction toward the axills in the first interceatal space, deeple enough to effect the interceatal spaces steroign the pectorals. Triction and kneed the claricular and sternal origin of the pectoral muscles. The outer half of the pectoralis major is thoroughly kneeded by the finger tips in the axilla, and the thumb over the front of the muscles, or better still be the finger typs of one hand above, the other below the muscles, performing a circular kneeding. Finish with efficiency to word the shoulder tip

a circular kneading. Finish with eliterings toward the shoulder try.

The Back—The patient is placed prone and on effort made to relax
completely the exector spinse muscles by placing a small pillow under the
class and tinglis. This may be more ideally done by an adjustable lan
mock frame similar to the Bradford frame. Effecting of the entire back
with both hands similatneously may be used, stroking the outer region
of the back upward and outward to the shoulder cup, the neck and typer
part of the trapezius from the occupant downward and outward to the
point of the shoulder. This is followed by strokes beginning at the neck
and continuing downward close to the spine, allowing the hands to separate
at the szerum, and pass to the outer point of the hips. A series of fretions, both hands working simultaneously, on either ande of the spine
and parallel to it, thumbs meeting at the spinons processes, may be given

starting from the neck and working down to the sterium repeated several times. Thorough kneading is then done, the hands placed pirallel, working on the muscles of the neck on one side and following the trapezius libers to the shoulder then on the opposite aide followed by the superspinatus, infrispinatus, rhambooks, erector spinae and other groups expirately. The creetor spine must be worked on deeply with the tips of the fingers and thumbs. Light trapstement over the heavier groups of muscles and down the erector spine is added where stimulating effect is desired. The treatment is completed by a thorough repetition of effleurage

# SUMMAPY

There are certain salient fiets in regard to massign and its use in therapeuties which it might be well to review in closing. We are not dealing with a single entity in massage but with a number of different manipulations upon the body which in themselves have distinctive physical ological effects. These differences may be further emphasized by the manner in which they are given is regards skill force duration and repetit tuns of the movement. If the underlying principles have been made clear the physician should be able to prescribe or perform suitable massage wherever the employment of any phase of it is indicated. Such intelligent choice of type and smount is of greater value to the patient than any degree of rechinical skill on the part of the operator. There has been on the part of the profession too great a tendency to place reliance upon the technical skill of masseurs, grounded in some one school or synamical tenders of the prescription for massage to patients and its proper correlation with other phases of physiotherapy will greatly enhance its value in the field of the represented.

## EXERCISE

Everuse is one of the fundamental body processes, and ranks with food, rest climination and respiration in the unportance of its relation ship to health. Modern civilization has medified exercise more than it has any other fundamental plac of human life. It will be shown that the efficiency of the body as a machine is to a very large extent dependent upon the efficiency of the muscular system. Every other important system in the body nervous glandular, respiratory, circulatory and even o wous is profoundly influenced by the activity or non activity of the skeltal nuncles. Too much consideration therefore cannot be given by the physician to this important subject. His advice if intelligently and faithfully followed will increase the efficiency of the average individual prevent illness and deformate and be has at his command a powerful prevent illness and deformate and he has at his command a powerful

muscle group, in both the anterior and posterior thigh muscles, with careful friction over the knee in the pophted space

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ion concentration in the blood passing through the respiratory center, and by nervous impulses of central origin which increase the ensitivity of that center

Under normal rest conditions the output of the heart is about 3,000 or 4,000 ec of blood per numbe. In extreme muscular effort this mount may be increased to almost 20,000 ec. Distole is a passive process depending on the volume of venous return flow. During active excrete bits return flow is sugmented by the increased mechanical pressure everted on the venus by the contracting muscles and by the increased rate and degree of the jumping action of the draphragia. The physiological limit to the division configuration of the draphragia. The physiological limit to the division configuration of the heart is reached when the puriously distinct is falled.

Pulse rate acceleration is dependent upon the time it takes to fill the aimcles. The main factor in determining the total output of the heart is the quality of its mu de fibers. The rate of contraction is increased by impulses from higher centers to the vigus center lessening the tonus of the heart fibers. At the same time the accelerators are stimulated. The maximum pulse rate is about 165 beats per minute in both trained and untrained individuals. The relative efficiency of their hearts depends on the amount of blood per beat that the contractle power of the heart is able to drive into the vorta. The net working power of the heart is decreased if the pulse rate is raised without increasing the total output rimunt. Or if its dilutation goes become the pulse longical limit per minute, or if its dilutation goes become the pulse longical limit.

Increased local blood supply to the muscks is obtained by increased blood pre are construction of the vessels in the splanchine area and the dilatation of those within the muscles themselves. It may reach from ax to eight times the amount of the circulation during rest

Oxygen is supplied to a working muscle in greatly increased amounts. Double tho usual amount is withdrawn from the blood. The increased concentration of the hydrogen ion leads to more rapid dissociation of evidence looking raisin, the evigen tension in the blood plasma and aid in, its pissage into the muscles. The heart itself demands must time to usual supply of evigen which is supplied by the cornary circulation.

During violent excition in up parts of the body act as a unit to supply the requisite power. The impulses to motor activity are issually instituted by the motor centers of the brini. Impulses to the middle increase the respiratory rate and runche blood pressure. Later the increased hydrogen ion concentration belop to set stans effort. The impulses from the entiral nervous system are truly increased under emotional stimulation which enables the heart to draw on its runch power, beyond that emotional stimulation and internal secretions especially adrenaling is probably small in increasing immediate working power.

Training increases efficiency in many ways. It is accomplished by

ther speutie agent in the treatment of many pathological conditions, which may already be present

In professional and husiness life, the amount of evereise tiken by the average person is almost ml, while the shilled trades are requiring the management of intracte machinery rather than manual work. Both mental application and the use of finer muscle coordinations are a druin on the stored nervous energy of the body. Reasonable use of the larger muscle groups, on the other hand, has the effect of increasing ultimately the body is

Physiology of Exercise - A brief review of the more important facts in the physiology of exercise will tend to emphasize the far reaching ef feets it has throughout the body. We are too apt to consider the subject from the standpoint of the skeletal muscles alone. The reader is referred to texts, such as that of Bambridge, for greater detail Muscle power demonstrates the body s efficiency as a machine. The active coordination of the entire nervous system and the cardiorespiratory system are essential in all vi-orous excreise. Such coordination is not essential and does not occur in any form of passive exercise or massage. The energy for muscle work is developed in the muscles the miches, and they transform potential into kinetic energy, and then renew their store of potential power during The liberation of energy in a norking muscle is probably a non oxidative process Oxigen is necessary to replace potential energy, which must be obtained ultimately from the oxidation of the food brought to the muscles by the blood I vereise mereises the demand of muscle for mitrition and oxygen Durin, severe physical exertion, the mu cles con sume from five to ten times the amount of oxygen that they is e during rest Io supply the oxygen, mercased activity of the respiratory system is essential. We have the increase of heart rate and vigor of contractions, rise in blood pressure increased depth and frequency of respiration, and activity of the central nervous system, all these being an essential con comitant of exercise

The available energy for muscular work is derived almost entirely from earbehydrates. Some of it comes from fits under certain conditions, but practically none from protein. Jates protein probably plusan important part in rebuilding the potential energy of the muscles. Lactic acid appears during muscular work, and the hydrogen ion concentration is probably vitil to contraction.

The efficiency of the body considered as a machine is rather low It waries from 20 to 33 per cent, depending on many factors such as training, speed of the movement, especially in relation to the so-called "matural rivthm" elimato and fatigue

The oxygen consumption during excrese varies directly as the amount of work and the degree of pulmonic ventilation, other conditions being equal. Greater a ration of the lungs is induced by the increased hydrogen

of functional and organic injury The pericardinm may become enlarged with the heart and permanently lowered efficiency of the heart result making muscular exertions either dangerons or impossible

Physical Education —There is a present and growing world wide in terest in physical training This is due to many factors some of which

The deplorable physical condition of nearly one-third of our manhood as revealed by that first national health census—the recent draft examina tions for the army

The realization that a soldier is no stronger than his heart, or the muscles and ligaments of his fect and back

The intensified interest in athletic competition for both boxs and girls.

The fact that in becoming a city dwelling nation, we are reducing

beyond the limits of safety the play space of our children.

The intensive study of industrial fatigue and its relation to efficiency. The fact that early physical deterioration and premyture depth is caus might loss to the ecountry of the services of too many of its business and professional men when they should till be in their prime.

Types of Exercise —The advice of the plivician is constantly sought regirding the type of exercise suitable to various conditions the possible dangers of athletics and how to sufeguard the participant from them

The general practitioner cunnot be expected to be familiar with all the phases of physical education which is becoming in itself a specially of incidence. However, with an adquate howkedge of the physically of everise and of some of the conclusions arrived at by those in this specially the physican should be able to give intelligent advice to patients on excrete problems.

Exercise falls largely into the following types speed, strength, on durance, skill and corrective. The last will be discussed under the

heading of orthopedie and medical gymnasties

Exercises of speed in which a given distance is covered in the shortest possible space of time, are suited to all ages up to thirty five provided the distances for childra and sholescents are materially set down. Illustrated he sprint running this might be a sife rule allow up to twelve years 40 varies, twelve to fifteen years 70 to 100 yards infecen to eighteen up to 220 varies depending, on training and condition

Exercises of strength such as weight throwing gymnastic apparatus work and wre thing are, those which require every ounce of one's energy to perform. They are best adapted to the ages of sixteen to torty years carefully graded for the immuture.

Exercises of endurance are composed largely of many relatively slow and rhythmical repetitions of movements easy in them elves, such as distance walking running shating distance withing running shating distance and relating running shating distance and seems games with long playing periods. They are suitable to any age

a steady and gradual increase in the amount of exercise taken. Diet, sleep and other factors and. The heart and the driphingm are developed simultaneously with the skeletal muscles. During severe exertion the trained individual maintains a lower blood pressure and pulse rate and the amount of physiological dilutation of the heart is less than in the untrained. During rest also his pulse is slower, but the hearts output per beat is greater than in one out of truining. The increase in the oxygen-carrying power of the blood, strent, the of respiratory muscles better coordination of muscles and keener judgment of the degree of effort required, all work to the advantage of the trained person.

Second und—that relief from distress shown by distance runners after part of the ruce has been run—is believed to be due to a fall in the alveolar tension of CO and a decrease in the necessary amount of pulmonic viculation from a deere used hydro-gen ion concentration in the circulators, blood

Fatigue is a lessined capietty for performing work accompanied by several subjective sensitions. The feeling of fatigue and its actual presence are not always the same thing. It may be general fatigue, having its main effect upon the central nervous system. This type is common. On the other hand, it may be largely local and due to a lessening of the snisitivity of the end plate of the motor nerve in the muscle by accumulated fatigue products, or to a marked depletion of the potential energy within the muscle. Rest and an efficient circulation soon restore the muscles to their normal or increased capacity.

The after effects of everuse The changes induced by everuse in the circultery and respiratory apparatus quickly subside. The general metabolic changes in the body return to normal more slowly. Everuse is beneficial when it stimulates these metabolic processes in the body and promotes functional efficiency. Improved circulation, digestion, climmaton and sleep should result. It has been satisf. There is no exidente that in a perfectly healthy man even the most intense exertion products any harmful effect on the heart. It might be better to say on the trained heart.

Effort syndrome—occurring during training is diminished ability to perform muscular work. This phenomenon is accompanied by evage greated respiratory and circulatory, changes during everies, and by he is of apptite poor sleep and feeling of lassitude. Athletic corches call this condition stateness. The contractile power of the heart is lessened by overwork, resulting in a failure of the chain of events we have spoken of which supply the working, muscle with an adequate supply of oxygen. A similar condition also occurs following the effect on the heart musculature of the toxins of acute and chronic infectious di ease and the lessened cardiact tomofor scelentary life. If the heart is serrously impaired, violent effort will be followed by pathological dilutation and other signs

which cannot be guarded against and the parents judgment is as good as the physician s as to whether it is worth while It teaches more things of value than perhaps any other game Basketball is one of the most strennous of games Water polo and print swimming and wrestling are also very severe. Crew rices over two miles in length are very taxing The 440 and 880 yard runs are harder than the sprints or distance runs

The Girl -A drastic change in the physical life of girls has taken place during the last two decides From beambigs crooner Delsarte and a sporadic attempt at bieveling, they have taken up field hockey ice hockey, their own and men's basketball ba et all summing association football and track and field athletics. This movement is no fad but is growing with each succeeding year. In its wike come serious problems for the physician, parent and educator the proper solution of which will vitally affect the physical health of the nation

Unquestionably there are many guins to the girl from athletics Courage, elf reliance aportsman hip and the ideal of teamwork' are tiu.ht The function of the heart lung muscles and the neuromu-cular coordinations are greatly improved. The e activities form as with the box, a rational outlet to superfluous energy. Ou the other hand, certain dangers are to be feared. The writers experience and research in this phase of physical education has led to the following conclusions

Athletics when properly centrolled do not toul to make the girl less

Moments

When given the same ears in regard to medical examination competent supervision and training she is in no more danger from heart strain than is the boy

The skeletal mu eles are in no way attached to the pelvic outlet or permenum and their firm development emnot meres o the difficulty of labor. On the contrary the better general metabolism stronger abdominal nuiscles and increased physical contrage developed by athletics are a distinet a et to the sonn, weman at that time

The is no dimmer of or, time do placement from the jumps and falls medent to ithleties prividing the jumpus, pats hurdles etc., are properly constructed and that the girl is in the athletic condition. The tone of all supporting structures is impressed in direct proportion to the im provement in the tone of the keletal mu cle

During men trustion helit exerci e such as marching tactics clubswingin, etc should be kept up Practice in certain phases of athletic such as be kethill got shooting and signed place form for the sprint start and similar plays may be u ed through the entire period. More agorous plays and even contacts may be permitted after the third day with most individuals The girl should not be allowed to term this normal function illness nor in the als me of a pathological condition should she greatly modify her routine activities Carefully followed up records of gradu

up to middle life, are never overdone by the child on his own initiative, but need careful approximon in early adolescence

Exercises of shill such as golf, bowling, quoits, enring, etc., are applicable to any age and are especially beneficial after middle life

Most term ports combine everal of these types and must be judged by their main elements. The factors of time or distance can be used to set a rea anable limit to the indulgence in them.

set a rea onable limit to the indulgence in them.

The ideal program of physical education should include at least four elements without all of which no such program can be called complete.

1 A preliminary physical and medical examination of every in dividual who is to participate in physical activities is essential. This examination should accurate the originic structure and functional power of the individual. Girth of foreirm upper arm and wirst are unumper tant, but the condition of kidness, thyroid, heart, lungs, spine and feet are trial. Before exercise is resumed, a current recommunition is contail after any illness or impury however slight.

2 Å carefully written prescription for special exercise should be given, to be curried out under trained supervision, whenever remediable defects are discovered.

3 Regular systematic body building exercise should be insisted upon for every one. Participation in athletics should be a special reason for taking this work instead of an excuse for omitting it

4 Athletics for all who are fit during at least part of the season may safely be built on this foundation. There is a place at the 'peal," for the arrange team composed of the phasically fit, earefully trained and conditioned who may with reasonable safety be allowed to specialize in streamons athletics.

The Child—When we chan, cd the sin, le hon e with its large varies to the multifunity apartment building, we cut down the play spice perfulid many fold. Formal school grunnestics and organized play under truined supervision can but partially compensate the child for this loss. The playsician should back exert effort to establish adequate playsiciant runner, in this schools and to provide sufficient city playgonids. One well truined playsical director is better than any number of unskilled in structors. Competent medical examinations cannot be instituted too early a school life.

nn senson lite

The Adolescent —This is the age where strennons athletic games are
indulged in It mut be remembered that rapid skeletal growth during
this period outstrips that of the cardiovascular issues. Heavy demands
are made on the bouth by development, stady and social activities which
inust be reckoned with in deciding on the proper physical education
program

The Boy -The shortening of the pliying periods in many games has added greatly to their safety Football still has elements of danger

which cannot be guarded against and the parents judgment as as good as the physician s as to whether it is worth while. It teaches more things of value than perhaps any other game Ba ketball as one of the most tremous of games Water polo and sprint swimming and wrestling are also very severe. Crew races over two miles in length are very taxing The 440 and 880 yard runs are harder than the prints or distance runs

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The ideal program of physical education should include at least four elements without all of which no such program can be called complete

1 A preliminary physical and incide il examination of every in dividual who is to participate in physical activities is essential. This examination should accertain the organic structure and functional power of the individual. Girth of forearm, upper arm and wrist are immipor taut but the condition of kidneys, thyroid, heart lungs, spine and feet are vital. Before exercise is resumed, a carcuit recommination is essential fifter any illness or injury however shelpt.

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The Boy -The shortening of the playing periods in many games has added greatly to their safety. Football still has elements of danger

- With hands on hips
- a Heels raise lower
- b Toes raise lower
- c Heels raise knees deep bend knees straighten heels lower With hands on hine
- a Trunk sideward right bend raise sideward left ben? raise
  - b Trunk sideward right turn sideward left turn return c Trunk forward lower raise backward bend raise
- 4 From position
- - a Arms forward rat e stleward carry farward carry lower b Arms sideward rat e forward carry sideward carry lower
  - c Arms forward raise upward carry forward lower downward lower
- d Arms sideward raise upward carry sideward lower downward lower 5 With hands on hips
  - a Pight knee raise lower
  - b Left knee raise lower
  - c Right knee raise extend leg forward knee bend lower
- d Left kn w raise extend leg forward knee bend lower 6 To stride stand jump arms sideward rai e
- a Trunk ben hing alternating right and left
- h Trunk turning alternating right and left
- 7 Hands behind heal
- a Trunk bending alternately forward and backward 8 Stationary running on toes with high knee raising

# THEORY OF MEDICAL AND OPTHOPEDIC GYMNASTICS

There are a number of factors relating to therepeutic evercise which have to be taken into consideration as well as the exercise itself. The personal and riesal inheritance of the individual his environment special stage of development, nutrition and other conditions all modify the result which we are able to attain by corrective exercises

Types of Exercise -- We use for therapeutic purposes four types of exercise

- 1 Passive, those done wholly by the operator or by the weight of the patient a body, or other external force
- Assistive, performed as far as possible by the patient, assisted by the operator
  - 3 Active, the movements executed entirely by the patient
- 4 Resistive, done by the patient opposed by friction, gravity weights the operators or the patients' own physiologically opposing groups of muscles

It is known that as the muscle strengthens its belly becomes thicker and the entire muscle somewhat shortened thus making the distance between its origin and insertion somewhat less. We are able to employ this tendency of strengthening mu cle to shorten in the correction of sev eral orthopedic defects for instance, in a faulty forward position of the ates of normal schools of physical training have shown menstrual and maternal histories better than those of the average woman

A committee of the British Medical Association, after a thorough in vestigation of the subject, reported approval of field hockey, swimming dancing and track athletics (they do not play basketball to any extent) for girls Basketball under the "Women's Rules" is a much less strennous game than that played by "Men's Rules," but the trained athlete may play either with safety Track and field athletics have reached the stage of international competition. Different events are suitable to different physical types The pole vault, twelve-pound shot put and middle-distance runs are very severe and should rarely be used. Distance running requires very prolonged careful training to be free from danger. The special value of this sport is that, unlike other team games, everything depends upon individual effort Furthermore, it necessitates the gathering of every ounce of energy for one supreme effort. Many times during his the ability to make a quick, sure, supreme effort may result in the saving of life or limb This ability is developed by track athletics almost ex clusively. Other sports teach better the lessons of team play

The physician should insist, then, upon the safeguards before mentioned, namely, preliminary and repeated medical examinations, trained supervision and proper equipment and conditions for the particular sport in question. With these provisions made and organic weakness ruled out, girls should be both allowed and eucouraged to take up athletics.

The Adult —There is a very pressin, need for games, recreational hygenes in character that can be played with safety and pleasure in spite of increased waistline and lengthening pears. Golf and volley hall are perhaps the best of these games and are being increasingly used by business and professional men. Tennis, when available, is good in early middle life and golf to the end of one's active career. A grad toil of good has been done by the recent popularizing of simple setting updilled in the control of the property of setting up excreases which should require not over as minutes to reper four times each and which will aid materially in keeping the body in good condition are appended.

#### SETTING UP EXERCISES

From "position"

a Arms to thrust raise forward thrust return lower

Arms to thrust rai e upward thrust return lower

b Arms to thrust rai e sideward thrust return lower

3 Gradual lessening in the flexibility and range of motion in the joints moved by these muscles

4 A dulling of their muscle ind joint sen c which makes us aware of the fact that we are, or are not, in good pos

ture

To illustrate take a case of round shoul ders

a The pectorals user in all vomewhat stronger than the houlder retrectors may have their relative advantage increased by general fatigue or weakness b The pectorals

lecume more contracted by the simple fact of the forward position of the shoulder and the rhomboids the tra pezums and other hould der retractors are stretched out and weak ened

c The anterior lima ments of the shoulder joint being cliden extended to their full extent tend to short n



FIG. 5-Use of Bopt Weight in Stretching Adme

d. The individual fiels perfectly comfortable in a slumpy position and finally becomes totally massare at it except when he may ack must fin a mirror or be reminded of it by others. This point is well exemplified to the exversice min who for months after his dicharge from service eithers him off-dimping, with decreasing frequency and finally forests the matter entirely except during a besture on po ture or an occasional military paralle.

Any exercice program for the treatment of po tural defects must.

there for a contain at least one exercise or position runed at modifying each one of the a factors. We must transition the weaker groups of muscles stretch those contracted maintain and increase full they about

head In this case development of the retractors will tend to maintain a better position of the head. All posture brices, except when used as temporary expedients, such as the protection of a partially prairized



Fig. 4.—Use of Body Weight in Streetching Floor Admissions (Courtesy Lauf B. Hocher)

muscle, have the opposite effect, namely, that of further weakening the muscle already below par

In prictically all faults in terminal transfer of head, shoulders, spine or feet, which are due primarily to defects in the skeleton, the following factors are present

1 Lack of bilance in the power of physiclogically opposing groups of muscles

2 A gradual short ening of the stronger shortened groups, with corresponding lengthen mg and weakening of the opponents We should visualize the muscles as strong elsa the bunds under prittal tension. When we are in fino condition, active and constantly moving

our joints through their normal range this difference in elastic pull does not result in faulty posture or deformity. Whenever there ensues a verifices or total privales are for muscle or muscle, rough through nerve injury, the tendency for contractures to occur in the uniffected opponents is clearly understood and usually guarded against. Some means are taken to main and increase the tone and the strength of the weakened muscles. These methods are taken up under the heading of peripheral nerve injury. It is not so well understood, however, that when there is general weakness from whatever cause the relative pull of the stronger muscles is greath increased, which gradually tends to increase the faulty posture. This condition is common in chronic fatigue.

general activity and special abdominal evereives. Special respiratory evereives may within reasonable limits mera et he lung capacity, tone up the splanehme circulation and affect results of chrome emporing. It should be recalled, however, that the normal stimulation to increase retained in the CO, or hadrogen no content of the blood, as it passes through the respiratory center in the medalla. Therefore, to induce deep breathing by existing the need for more oxygen in a normal manner is better than artificial deep breathing. A stationary rule or vigorous gramastic daneing steps are therefore, better than forced deep respiration.

The subject of the physiology and physiological effects of general conditioning evereives for the adult and of play, gymnastics and thickies for the joung inquestionably hes in the field of preventive medicine. The points brought out in a study of these evereives have been dwelt upon at some length because they do not appear in medical literature to any grut extent and are scattered throughout the writings on physical education in such a way as not to be easily available to the physical. The possible dangers of heart strain and other physical injuries in athletics are real, and yet the value of sports to the young is so great that a detuiled study of the subject is thought worth while. The family physical is being, called upon for decision in regard to athletic indulgence with mercaaning frequency. Medical and orthopedic gymnastics constitute a real and growing part of our therapeutic armsimentarium. The increasing interest of parints and educators in these phases of treatment requires that the physican be adequately informed regarding them.

and recducate the muscle sense, while attempting to increase the general body tone

c. I notly we must see to it that the child is built up in his general physique through given il, bilateral exercises, play and improved byticm

Before treatment for any given postural defect is instituted, the causes for such idefect must be carefully studied and, where possible, removed. The special treatment for these conditions, such as affecting land, shoulder, spin and feet, are taken up in detail in their special sections. It will be found that the causes for most of these conditions are in general quite sound and full into two mann groups, which we might term the strain and the resistance.

In the former group we have defects of he ering, vision, improperly constructed school sexts and the babitual undustrial methods of currying birdens, especially by children, the construction of ill fitting and in properly applied clothing. Clothing supports and abnormal attitudes

assumed to relieve pain have also to be considered

The factors, on the other side, which lower the resistance of the body in the strains put upon it include malimitation, too rapid growth, the effects of toxins of aente and chrome discuss, and the Jack of normal healthy also and a variest

It is evident that if the strain is areat enough even the relatively normal whili may be deformed, while the child below pur physically may be uffected by comparatively slight habitual strains

The curves found in the first group mentioned should be removed or bissened, as far as possibly, in every case of postural defect. Attention should be carefully directed toward any of those ectological conditions found in the second group which can be removed.

It would obviously be futtle to prescribe a set of severe corrective exercises for a child so undernourished that he is mushle to carry the regime of study and work already imposed upon him. This burden should be light ned, his diet mode amph, until he has sufficient physical foundation for special work. He should, figuratively speaking, be turned out into the pasture. In fact, many diffect rapidly disappear when these general fundamental indications are takin ever of

crait initiation that indications are used in the foundation of various organs of the body both directly and indirectly. The heart, being used a number of the body both directly and indirectly. The heart, being used a number may be care fully and progressively trained to improve direction, except in those cases where organic lesions have progressed too far. I unchoining of the nervous system may be markedly affected by reclineating, the neurol muscular coordination. In fact, with subnormal children, a marked toming up of even the higher mental processes has followed systematic and thorough training, of this type. The activity of the justic intestant tract and the glands which supply it may be favorably affected, both through

general activity and special abdominal evereises. Special respirators exercises may, within revenable limits, increase the lung capacity, tone up the splanehne circulation and affect results of chronic emptern. It should be recalled, however, that the normal stimulation to increase respiration is the meresse in the CO₃ or bydrogen no content of the block is it pisses through the respiratory center in the medulla. Therefore to induce deep heating by creating the need for more oxygen in a normal manner is better than artificial deep breathing. A stationary run or vigorous grammastic discussions, and therefore better than forced deep respiration.

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## CHAPILLAT

### MI CHANOTHERAL Y

# WHEREN I HEREN

Historical and Introductory—Of all theripentic means need by man up to the present time the application of exercise for the restoration of boddly function most nearly approaches nature a own incided of maintaining function.

This when exercise was first unitized in a therapeutic way is not known certainly the eithest writings of the Chinese and Hindia indicate that these people idvo ited the use of exercise in a hygicine way. The Greeks at the prime of their eivilization, imploved the bith and exercises and wrote of these methods as a means to maintain bodily function. Through the Greeks the Romans learned of, and improved upon, the methods. Through the middle agas little advance in this subject was made and, in fut, it was not until the securical and eighteenth centuries that securities that we match thought was turned to exercise, and further advancement made.

I riedrich Hoffman, a German, 1780, and later Peter Hanno Lug 1780, 1813, a Swalesh symmet developed this subject and formulated specific free movements, upon which all modern systems of free excress are still based. Lug's work definitely connected everuse with masses, which mampulations he classed as "passive gymmatics". He started in the sea fencing teacher and was attracted by the binefits derived from exercise in developing the Central Institute of Gymnastics in Stockholm. From his writings and those of others, it would seem that he appreciated the application of exercise but lacked the scientific knowledge of its indictions or centra indications. His work, however, with that of Metzger, a plasser in it in Holland, attracted the attention of many of the well-known physicians of that time and it was following the influence of these two men and the investigation by scientific medical men, that medical gain masters found a place in the entrendium of the physicians.

About the middle of the list century, Greine Zinder devised some ingenious apparatus to localize exercise to a liven part and to chiminate, to a lirge extent the grammat who, according to the Ling system, was symportiat. These machines were so constructed that both active and passive motionent was possible

Io-day, much motherapy as utilized is a department of physical thera puties and used in conjunction with the other physiotherapoints means for the restoration of function. Its aim is to curview systematically those organs forming the motor apparatus, thereby primarily improving or restorms, their function and condurally improving, the function of the other organs of the body.

The necessity of treating this subject in conjunction with other physictherapeutic means has been apprec ated by those who did so much scientifi cilly to advance, exercise as a means of treatment. During the period of development of this form of treatment massage was usually used in conjunction with exercise, and duran, the recent War large departments were formed in the army bospitals of those nations engaged in the war combining not only exercise and massage, but also all the other known hysical means for the improvement or restoration of function, such as baths heat in its various forms and electricity. At the present time many institutions have all of the e-departments correlated under a physical therapeutic director. This development has been quite rational, for it is casy to see that the enlarged or diseased portion of the body will tolerate active exercise better if preceded by mas and and in turn will tolerate massage better if preceded by one of the various forms of heat. It seems logical that the future development of mechanotherapy lies in its being further developed as a department of physical therapeuties

In judging the effect of exercise one should understand the purposes for which exercise a usually prescribed. These are threefold

- 1 For educational purpo es
- 2 for direct restoration or the improvement of function of a disca ed or injured member of the motor apparatus

For the secondary or indirect improvement of function of those organs not units of the motor apparatus per se

It is though the combination of rist and exercise that the body is maintained in a state of health. Fixees of either of these is not beneficial bluest und exercise given to chool children either in the form of gain is tree or sports has shown its value in increasing growth general diel pinout ind endurince sufficiently well to require no length explaination at this time. All the armies of the world lives kept their soldiers in it is to of physical fitties a through the routine application of exercise.

### THERAPEUTIC EFFECTS OF EXERCISE

We are here chefts concerned however in the effect of evere e from a therapeutic tandpoint and will consider the effect of evere e from this standpoint. The units forming the motor apparatus of the body are made

up chiefly of bone, joints, muscles and their nerve supply. It is well known that the ordinary physiological exercise performed in daily work conduces to physiological hypertrophy of muscle, thus the occupational development of the blacksmith or iron worker may be seen in contrast to the underdevelopment of the sedentary worker. It is not only that muscle hypertrophy is seen following exercise, the development of the bony structures follows directly in children at the age of one year, when most children begin to walk. The bones are soft and lack, at least from a radiographic point of view, the strength and internal structure seen in children who have walked for even a few months. This has been clearly expressed by Wolf, whose word is law on the development of bone, and who states that change in the formation and function of bones, or of their function alone, is followed by certain definite changes in their in ternal architecture, and equally definite secondary alterations of their external conformation in accordance with mathematical laws" Con versely, patients who have been bedridden for some time, lacking normal exercise, are seen to show a wasting and lack of tone in their muscles. and splinting of one of the extremities for even a week or two will produce definite atrophy of the part. This is further confirmed by radiographic examination where, after prolonged rest, the bones of the immobilized part will show the well known atrophy of disuse. These changes are in all probability due, in turn, to the effect of exercise on the circulatory system When a muscle contracts, the venous blood is mechanically pressed out of the years in and around the muscles As the muscle relaxes, more venous blood is sucked into the recently compressed vessel This hastens the speed with which the blood normally passes to the part, thereby placing a demand for more blood to the part, with a resultant dilatation of the arterioles in the part Coincident with this, the lymph channels hasten their flow

Of secondary importance are the fascial coverings of the muscles which upon contraction and relaxation of the muscles act as a sort of compressor to the muscle as a whole valuing in the compressor and relaxation of the vessels within This may be seen in the neck where, in hyper extension, the fascial sheaths compress the large external jugular veins, depleting them of blood Bs shilffully applied exercise one may actually deplete one portion of the body of blood, as is so commonly seen where hyperemia in the head resulting in congestive headache, is relieved by a rapid short walk. It must be remembered that with alteration in the length of muscle and fascia, which increases with active or passive exer eighter is a coincident change in shape in the blood vessels of the part, so that in relaxation the vessel is longer and narrower, while in contraction the vessel is shorter and wider. This change in shape assists in increasing the rapidity of the flow of hood through the part. When these local changes occur in the larger vessels of the body, such as the femoral

or saillary, there is a definite demond pheed upon the heart for increase dietivity. The response is an immediate incree in the heart's rate due to the increive of blood thrown into the right suricle. As the heart ridsited of this blood by increasing its rate and force, there is an intividilation of the larger strens to receive it which as the exercise is increased and the blood is more evenly distributed causes a diminution in the size of the artery, thereby increasing, the blood pressure

The products of oxudation produced by muscle activity stimulate the respiratory watern to further work. The cell of the body for further work in the not shown itself in the increa ed activity of the respiratory organs. With most general evereit in the deepen of the chest are brought into function and this is further increased in the demand of the body for further oxygenation, and furthermore acts mechanically upon the heart. This call for increased oxygenation in even moderate exercise results in a filling of the lungs which under normal breathing fall to fill completely, decreasing the amount of residual air and in time developing the lung power. The cloic relation between the circlise and pulmonary systems under exercise cannot be underestimated when one is unlikes not only their mechanical proximity but the marked influence of the pulmonary circulation upon both the cardiscs and reputatory systems.

Effect of Exercise on Digestion—One of the most important factors in the effect of exercise upon the digestive system is the action of the disphragm. Foreful contraction of this muscle increasing intra-shdominal pressure, increases the rapidity of flow in the great splanchine ressels and also everts some pressure upon the vena cvi as it passes through it. Increased activity of the disphragm and of the abdominal muscles improves the peristilite section also according to some authors setting as a crit of liver and gall bledder massage. The increased peristilite section places greater demand upon the internal secretory glands im proving the absorption and assimilation of the food which in turn results in an improved nutrition of the body in general

The striking effect of evercise is cen among those who do active out door work. It is not uncommon for such people to have a daily intake of from 4 000 to 4,000 calories while those of edentary occupations rarely

ingest more than 2 000 to 2 .00 calories per day

Effect of Exercise on Nervous System—One of the most important effects of evenise is seen upon the hrun and nervous assisten. This is particularly true of special exercises given for therapeutic purposes. Precion in movement requires an alert mental effort and rapt attention to the work at hand. In exercises directed locally the patient is required to differentiate between the workings of the individual mucele groups supplied by various innervations giving hun an acute appreciation of control of the various micele groups. This is of particular value in case of partial paralyses where the improvement of the remaining misseles of

up chiefly of bonc, joints, muscles and their nerve supply. It is well known that the ordinary physiological exercise performed in daily work conduces to physiological hypertrophy of muscle, thus the occupational development of the blacksmith or iron worker may be seen in contrast to the underdevelopment of the sedentary worker. It is not only that muscle hypertrophy is seen following exercise, the development of the bony structures follows directly in children at the age of one year, when most children hegin to walk. The bones are soft and lack, at least from a radiographic point of view, the strength and internal structure seen in children who have walked for even a few months This has been clearly expres ed by Wolf, whose word is law on the development of bone, and who states that change in the formation and function of bones, or of their function alone, is followed by certain definite changes in their in ternal architecture, and equally definite secondary alterations of their external conformation in accordance with mathematical laws" Con versely, patients who have been bedridden for some time, lacking normal exercise, are seen to show a wasting and lick of tone in their muscles, and splinting of one of the extremities for even a week or two will produce definite atrophy of the part. This is further confirmed by radiographic examination where, after prolonged rest, the bones of the immobilized part will show the well known atrophy of disuse. These changes are in all probability due, in turn, to the effect of excreise on the circulatory system When a muscle contracts, the venous blood is mechanically pressed out of the years in and around the muscles. As the muscle re laxes, more venous blood is sucked into the recently compressed vessel This hastens the speed with which the blood normally passes to the part, thereby placing a demand for more blood to the part, with a resultant dilatation of the arterioles in the nart. Coincident with this, the lymph channels hasten their flow

Of secondary importance are the fascial coverings of the muscles which upon contraction and relaxation of the muscles act as a sort of compressor to the muscle as a whole, adding in the compressor and relaxation of the vessels within This may be seen in the neck where, in byper extension, the fascial sheaths compress the large external jugidar vens, depleting them of blood By skillfully applied excresse one may actually deplete one portion of the body of blood, as is so commonly seen where hyperemia in the head, resulting in congestive beadache, is relieved by a rapid short walk. It must be remembered that with alteration in the length of muscle and fascia, which increases with active or passive exer case there is a coincident change in shape in the blood vessels of the part, so that in relaxation the vessel is longer and narrower, while in contraction the vessel is shorter and wider. This change in shape assists in increasing the rapidity of the flow of blood through the part. When these local changes occur in the larger vessels of the body, such as the femoral

Physiology of Muscles -Pefore considering this very important aspect of muscles, let us review briefly the histological atructure of muscle, upon which its physiology depends. The es ential unit of the muscle is the fiber-a minute highly specialized body cell, appearing as a minute thread verying from 01 mm to 1 mm in diameter, and from 5 to 15 cm in length. This is made up in turn of a sarcolemnal sheath within which is contained the sare us ub tince or muscle plasma. The sarcolemma is a structurely , ela tie membrane and it alone comes in contact with the connective to me he which the muscle fibers are attached one to another The muscle plusma is made up of long threadlike fibrils which, being of alternate light and dark bunds, give a characteristic ern s struction to the mu cle and which are the es ential contractile portion of the muscle. The viscous material between the fibrils, known as the sire pla m, is supposedly the nutritive element in the muscle fiber Muscle fibers are banded together by delicate connective tissue which groups them into primary bundles this connective tissue portion being known as the endomysium. The she ith surrounding the primary bundles is the permission These primars bundles are again grouped into econdary bundles and enveloped in a sheath known as the countysum tach secondary bundlo being known as a separate muscle fasciculus

The physiological properties of stricted muscle are

1 Contractitity—By thus we mean its ability to shorten itself in re-point to a stimulus by which it is able to perform its work. The normal stimulus is usually the naive impulse, coluniting in the attracted muscles and acting reflects in the inistrated muscles which this property of entractitities by reason in all muscular itsue, it is not confident to muscular tissue being all o a property of the ciliated epithelial cells of the manufalian body. Through this contracted power muscles shorten throughlyes in varying degrees this variation being from 10 per cent to object cit of their normal langible during physiological excesses.

2 Fitnability—By extensibility we indicate the power of muscle to permit of lengthening subbat tearing. Most muscles are stretched between their points of origin and insertion. We know that if a tendon is cut veen with the muscle relaxed the fit by part of the muscle draws the tendon toward its origin. This light stretching under which the nuncle are normally maintained assets very much in the smooth working of the mytor apparatus. This power of extensibility, when studied in comparion with the exten thirty of deal details, below its found to drift; markedly from them. While the extensibility of an ely to be portionate to equal increments of weight the same proportionate decrease with each equal increment of weight. It has been found that the decrease in the power of extensibility to increments of weight holds true up to the point where a nuncle racker.

the same group would, to some degree, compensate for the loss of an individual muscle

Frunkel has correlated a complete system of exercises which have accomplished much in retraining those suffering from bocomotor ataxis, utilizing the other sense perceptions for the lose of muscle sense perception. The effect of exercises on purely functional neurological conditions is not to be disregarded. By means of properly applied exercise, either a sedative or simulating effect may be obtained. Many of the purely functional neurological conditions have recently been explained upon the basis of an endocraristhemia, and it is possible that the effect of everice in these cases is accomplished by the physiologically improved function of the organs of internal secretion through increased blood supply and mutrition.

Effect of Exercise on Genito urinary System — The most important phonological effect of evereic on the genito urinary system is the ten incomparing the form of presence concession when present in the kidney. The changes above noted in the excellence is system, the distribution of blood to other parts of the body, the disphorees occurring with exercise, all relieve the kidney of work which it would ordinarily be called upon to do. However, this is a rather transient accomplishment, and does not wirrint the prescription of exercise for disfunction of the kidney, and in circfully selected cases. The reflect depletion of the blood to the entire genital apparatus is of more importance, thereby leasuing local arritability.

Effect of Evercise on Metabolism —No other therepeutic agent his so definite an effect upon inctabolism is evercise. Howell his tribulated the mechanisms of heat production and heat dissipation as follows

Heat production

Chemical regulation

1 Motor nerve centers and motor fibers to the muscles

2 Stimulating action of food on metabolism

Heat lo s Physical regulation

1 Sweat conters and sweat nerves

2 Vasomotor centers and va omotor nerve

3 Re piratory center

In this we see the important metabolic process of heat rigulation definitely acted upon by exercise. Heat loss through the swert centers, assemblor centers and respiritory center, is definitely accelerated ever et e, while, on the other hand, heat production, although of chemical regulation, is likewise accelerated by exercise. The acceleration of the metabolic processes has, connected with it, an acceleration of the gistive functions, permitting, more rigid absorption. This not only permits a greater intike of food, but its more rigid absorption, thereby improving the general body economy.

leg, the hamstring muscles are shortened and are artive concentrically II, however, the same patient with knee flexed attempts to hold the knee in this position and is overcome by the force utilized by the masscur or machine, the flexor muscles are atill working but actually being lengthened while working and hones are and to work occentrically.

Active motion is also divided into three phases of muscle action

1 Positive phase in which a muscle contracts

2 Static phase during which the muscle is maintained in a state of complete or incomplete contraction

3 Negative phase during which muscle ends are gradually being separated

To illustrate—during dorn flexion of the wrist the extensor carpulnars and radials perform a positive action. If the wrist is now maintained in dorsi flexion without further movement a state action of these muveles is seen. As the wrist is then lowered complete, relaxation of these muveles does not occur immediately but they are gradually leightned as the wrist is brought down. This is the negative activity of a muscle.

One of the most important factors in proper application of exercise is the localization of the treatment to the joints and inviseles to be ever exised. If we take, for example, a foot condition wherein adduction exercises are indicated, and during exercise permit the patient to pluntar flex the foot alone, instead of adducting we are defeating the purpose for which the exercises was prescribed.

According to Schwann's law of the physiological action of muscle whose when the strength of a muscle is in direct proportion to its strict of couraction. This is of importance in graduating the dosige of resistance in giving resistive movements for, at the beginning of contraction and at the call the strength of the muscle is less and so that the resistance should be strongest in the middle third of the movement. Again in the treatment of a rigonerating musual paral merce, when the extension of the wrist and fingers are beganning to show return of function if we instruct the patient to move the wrist in extension as much as possible mixed of ordering a few brief, well directed extension movements to his wrist he will in his efforts to extend the wrist activate his fictor groups as soon as the exten or muscles are fatigued thereby actually culturing the exten to be detrimental to his recovery. The progression of extreme should be gradual and may be accomplished by increasing speed duration or resistance applied in the extress.

General Exercises—We know it is general bodily activity that main tain the harmonious reordination of the various systems of the body. It is reasonable, therefore, to suppose that in the application of exercise in a therapeutic way, active free exercise offers in a timprovement

its normal physiological limit of extension. If equal weights are added after this point the muscle follows the law of dead elastic bodies and extends in equal proportions to each added increment of weight Extensibility remains a property of muscle even after ricer merits.

- 3 Elasticity—Whin a muscle has been extended within its physiological range of extensibility and the extending force is removed, it regains its normal state through its power of elasticity. This property is found only in living mwele, and although it is not as great as the elasticity found in some dead elastic bodies, its clastic power is none the less perfect. The slightly stritched condition of muscle between its origin and insertion probably tends to maintain the tone of the muscle, thereby making more smooth the clastic recoil.
- 4 Irritability—Musch irritability is the functional activity of a musch in response to a stimulus. The normal nerve stimulus was first climinated by Claude Bernard, also, by injecting curace, paralyzed the motor nerve endings. Direct stimulation of the curarized muscle, either electrically or mechanically, initiates functional activity within the muscle, demonstrating an independent muscle irritability.

It is through these four properties that muscles perform their normal work and through the improvement of these properties that exercise restores function to the muscle

# CLASSIFICATION OF GYMNASTIC MOVEMENTS

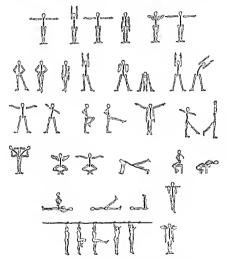
Ling classified all movements as follows

- Passive maxemints or tho a aberian no active innervation is performed by the individual the motor power being supplied by another person or by suit able live authoratis.
- 2 Active movements or those wherein the individual innervates his own muscles and performs work through the movements of his inuscles. Active movements are again subdivided into
- a. Free movements those performed by the individual without external help b Controlled movements by which is meant those exercises limited or sup
- ported by various apparatus

  c Peasslance monoments during which the setive movements performed by
  the patient are re isted by the gymnast or by apparatus

Resistance movements are said to be either concentric or eccentric. Concentric movements are those in which the muscle, while working against resistance, shortens its total length, while eccentric movements are those during which the muscle while working is gradually length end by the external force applied. This may be illustrated by resistant movement, when a patient flores his knee with the resistance of the masseur?'s hand or machine directed against the back of the patient's

contractions in especies, ligiments or synovial membranes may be definitely improved by gradual, slow, even movements given over long periods of time. Possive evereives are rarely indicated in the lower



110 "-A 12W DERIVER MOVEMENTS FROM THE PL DAMESTAL PO ITIONS

extremity for whit cannot be accomplished by ordinary walking will surely not be accomplished through the application of passively applied in venices.

Mechanical Aids -- Vany kinds of apparatus have been devied to exercise a part or the whole of the lady. Among these the best known

in bodily function, and it is only in those cases wherein active free evereises cannot be accomplished that the pissue form of evereise of the use of mechanical means are indicated. Many so-called systems of active evereises have been developed but none have superseded the original Swedish system originated by Im., and his followers. This school had, as its basis, five fundamental positions, numely, standing, sitting, heed ing., lying and hauging. From these positions the derived positions were taken. For instance, from the standing position arm, leg and trunk evereises are given. Lakewise, from the sitting position the arm, leg and trunk evereises may be given, and so on, utilizing the fundamental positions as a starting point and building the individual evenies or derived positions from these fundamental positions. It is readily centered that countless numbers of combinations of excresses may be worked out



Fig. 1—Pt Name And Postriovs rison which Frencises May Pe Dearker in things a table of etercises for a given condition the atonding or lying position in fit utilized from which derived movements are made dependent upon the fatt ability of the patient. As improvement is gained the period of exercise is leading need gradually manual resistance may be offered and still later other fundamental positions utilized until eventually the patient is able to tolerate all of the versus fundamental positions with their derived exercise. In the local treatment of a part by exercise resistance movements are of greatest value in improving local function.

from these fundamental positions The accompanying sketches illustrate the five fundamental and a few of the derived positions from the various

fundamental positions (Figs 1 and 2)

Passive Movements—P usive movements leve heretofor, been cred with d with far greeter range of appheability than they are to-day. Those who are constantly using, excresses in a therepeutic way apprenate that, uside from the relatively limited number of cases wherein actual joint stretcling is required, or where the slight local circulators improvement resulting from passive motion is indicated, passive excresses have little therapeutic value. It is readily seen that where a muscle fails to receive its own nerve supply its irritulative, and contractility are not stimulated to activity. It is true that the clasticity and extensibility of the muscle are called into play but the mjury sustained by the contribute fibres would hardly be compensated for by the improvement guind in the elastic or extensible structures. However, passive movements have an important role to play in the treatment of chronic joint affections, where

contractions in expendes, ligaments or synoxial membranes may be definitely improved by gridual, slow, even movements given over long periods of time. Passive eventises are rarely indicated in the lower

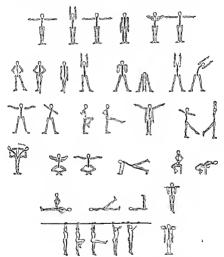


FIG -A LEW DERIVED MOVEMENTS FROM THE PUNDAMENTAL POSITIONS.

extremits, for what cannot be accomplished by ordinary wilking will surely not be accomplished through the application of passively applied movement.

Mechanical Aids - Vinn kinds of apparatus have been devi el to everu e a part or the whole of the body. Among these, the best known

are the Zander, based on the principle of the lever with movable weight, the Krunkenberg pendulum apparatus, and the Herz modification of the Zander appiratus. If we disregard the passive movement machines, whose sphere of action is very limited, we find that the importance of the machines lies in the resistance to efforts against a muscle, and the localization of evereise to definite muscle groups. This resistance may be afforded by the weight and lever Zander, by friction against a brake in the turning of a wheel, or by stretching or compressing springs. The principle of raising a weight by means of a lever his more recently been modified to raising weights by rope and pulley. Scholz, un his Manual of Mechancherapy states that "apparatus for

Scholz, in his Manual of Mechanotherapy states that "apparatus for medical gymnastic exercises should meet with these requirements

'1 It must be constructed in such a way that the patient in the apparatus is in the correct, original position, that is, the apparatus must prevent any indirect, secondary contractures of muscles. This is obtained by arrangement for support and fixation.

"2 The apparatus must allow the intended position properly to be

view

3 It must allow exact dosage and control of quantity of exercise
"4 Apparatus for resistive movements must allow exact dosage and
regulation of the exercise which is to be given"

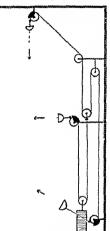
Following Ling's development of a ritional system of free exercise. Zander constructed apparatus by which exercise might be given without the assistance of a trunced gymnast. Ho constructed in all some thirty six machines for active movements, including those for the upper and lower extremity and trunk. He then devised motor-driven apparatus for balance movement, passive movement, including precursion and kneeding and friction. Along with these, machines for the correction of scoloses and various mensuring apparitus completed his contribution to mechanotherupy. The machines for active exercise were constructed on the principle of the weighted lever, by which certain muscle groups were activated by the movement of the lever. Motor-driven passive excress machines were constructed upon the same principle, and were of definite value in that the smoothness, continuity and uniformity of the movement was superior to that applied by a gymnast.

The advantages of the Zunder appraxis he in the graduation of the force and resistance, the human factor of the gymnest being climinated However, the proper application of the machines requires the attendance of one trained in therapeuties of evereises to gage the amount of resistance required and to sense the expressions of fatigue when the

exercises are applied. In addition to this the machines are expensive, rather cumbersome to operate requiring motor force, much space and shafting and the con tant care of a mechanic to keep them in working order Where these are not ob-

jections the Zander apparatus may be used with decided benefit

Under the stimulus of the war, E A Bott, of Toronto and R Tast Mchenzie of Philadel phis, developed simpler appa ratus based on the rat int of weights by rope and pulley prin ciple and of extreme simplicity in construction The central principle of rusing weights as in the Lander apparatus is maintained and the objection able factors, namely the cure bersomeness difficulty of oners tion space and technical knowl edge required in the lander annuratus are cluminated These machines are constructed so as to exerci o one movement in a joint and are all active motion machines save the e for evenin duction in the wri t and ankle These are so-called active-pas-#110 machines that is the morement is started as in the hrank enlar, pendulum apparatus by revoluting a wheel to start the everer e, and the wheel is kept moving by the activity of the Bulnut sown muscles Many of the machines are fitted with scales particularly those for the



3-TRIPLICATE PULLET WEIGHT MACRINE By Wat in I s intance May I'm Dereuen I PWARD DOWNWARD OR IN THE HORIZONTAL Description

hands and feet whereby a patient man actually co the graded improvement, and this acts as a stimulus to further effort. The triplicate-pul les weight machine shown in Figure 1 shows the simplicity whereby risi tance may be arranged upward downward or from the side It age or rea tame as graduated by the addition or elimination of wer ht

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Lucreuse 2 -- Horizontal attachment Flex interphalangeal jointakeeping inctacirpophlangeal joints extended

Exercise 3 -- Low attrehunant Extend metacarpophalangeal joints, keeping metacarpophalangeal joints extended

I xercise 4 - Low attachment Extend metacurpophalangeal and flex

interphalangeal joints

The operator sected approve the patient should count the repetitions and encourage his efforts. Each excress to be continued till movement how flaggin, and then stopped. The most convenient neights are shot la, louded to two conics with and ittached by hooks. They can easily be under and repaired by the mass cur.



-FINGER TREADMILL.

3 Thumb Adduction and Abduction—II und in pronution—Attach the stool on the radial side to the thumb for adduction

Lecture 1 -Driv the thund sero s the hand. Repeat the movement to the point of exhan tion

I receive a - Attach the stool on the niner side of the thumb draw thumb out in al luction. Le peut to exhaustion

4 Finger Treadmill (1), )—For coluntary florion of fingers. Strip the writt and turn the wheel by the unite beingers in turn till exhaut in of each major. The amount of work done by a single finger can be clashifted by using that finger only, and noting the weight and distinct its rived.

5 Circumduction of Wrist for Stretching (Fig. 1) - Strap the wrist and forcism grap the handle and turn the wheel about twenty revo-

McKenzic gives the following instructions for the use of the various types of apparatus

## HPPEL EXTREMITS

1 Finger Board — (a) For stretchin, contractions of the fingers, in flexion, and (b) for stretching abduction at the metacarpophalanged to the financial counts.

Patension of Single Pingers —(a) The fingers are placed on the board in moderate flexion, and the finger under treatment goes up the star, step



FIG 4-TINGER PULLETS

by step Note the last step at which the finger under treatment can be rai ed from the step without assistance. Depress the hand to stretch still farther

(b) Place the index finger against the peg at 1, and spread the second finger out, noting the farthest point at which it can fouch the pe. Repeat with the second, third, and fourth fingers

Repeat each movement not more than five times

2 Finger Pulleys (Fig 4) — For flexion and extension of the fingers, strap the wrist and arm at the elbow, meert the fingers into the glove stools and add weight until it can hardly be hitted by the voluntury power of each finger. The weights are increased as improvement gots on, and the movements repeated up to the point of exhaustion

Exercise 1 -High attrehment Flex metacarpophalangeal joints

keeping interphalangeal rigidly extended

Exercise 2—Horizontal attachment Flux interphalangeal joints keeping in the around lan-eal points extended

Exercise 3—Low attrehment Lytend metacarpophalangeal joints keeping metacarpophalangeal joints extended

Exercise 4 -Low attachment Extend metacarpophalan cal and flex

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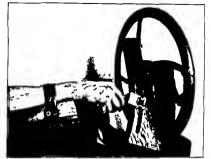


Fig. 6—Circumscerion at the Wrist Apparatus may be used actively and passively lutions citch was. More out the attachment to the farthest possible point compatible with the movement. The operator may assist at the most difficult part of the turn by turning the crank.



FIG 7 - ABDUCTION AND ADDUCTION OF WHIST Note scale showing range of motion and small handle to brake muchine to increase resistance

6 Adduction and Abduction of Wrist (Fig 7) —Place the fingers under the straps on the hand board, strap down the wrist and forearm,

adduct and abduct the hand noting the range of movement on the protractor. The weights will vary for these two movements, which should be done separately.

7 Piexon and Extension of Wrist—(a) Grasp the roller overhand and wind up the weight, everting the full range of movement without releasing the grasp. The scale will measure the range of the joint and the weight and distance multiplied gives the total work done in foot punds (b) Reverse the grasp and repeat for flexion

8 Pronation and Supination (Fig. 8) —Patient stands facing ma chine and grasps the handle with the left hand, his left elbow joint flexed



FIG 8 -- PROTATION AND SCREETING OF 11 KINT

his right forearm acro's his lich, and his hand graspin, his left arm above the cllow to privent edeways movement. Set weight and ratchet for impuration and turn, counting the cheks for each movement and noting the weight and the distance raised. The measurement of each moviment will appear on the protractor. In the protection of the protractor is ratchet and repeat for proposition.

9 Flexion and Extension at Elbow—(a) The patient faces the triplicate machine graping the floor handle the arm and cord in line Flor and relax the forvers (6) Patient faces away from the machine grasping the shoulder handle the arm fall faxed the upper arm in line with the cord 1 attend and relax the forearm. In both these exercises the position of the upper arm must remain unchanged. If this is not done, the direction of the pull is changed.

10 Shoulder Rotation —Grasp the floor handle the clow on a bracket, shoulder high, the forarm fleved to a right angle Pull up with the hand, throughout whole runge of shoulder movement without changing the height of the clow or its angle of flevion

11 Flexion and Extension of Shoulder Joint—(a) The pitient stands with his back to the floor hundle, the arm down and straight Arm forward, ruse and lower (b) Face to the floor hundle, draw the arm

hick, and lower to position

12 Adduction and Abduction of the Shoulder—The patient stands with the side to the triplicate machine shoulder attachment, arm and coal in him (a) Bring the arm forward across the chest (b) Patient stands

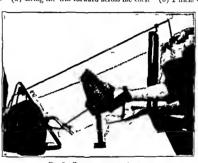


FIG 9-CIRCUMPLETION OF ANALL

as in I versise 1 but using the floor ittlehment. Bring the strught arm upward and lower to position. (c) Putent stands with his side to the machine overhead attachment, arm in line with the cord. Bring the arm downward and forward then downward and backward, alternated. (d) Patient stands with the side from the machine, the arm scross chest, grasping the shoulder uttachment. Extend the forearm and arm, keeping them at the shoulder level.

13 Passive Abduction of Shoulder—Patient studing with the side to the creeping board, and the forearm rigidly extended. Climb up the board by the fingers with a strucht arm, and note (a) the highest point at which the fingers can be lifted from the board by the patient (b) the level to which the pitient can bring up his arm without bending his elbow.

General movements that are of value in treating the impseles of the upper extremity are rolling up a bill of paper throwin, and catching balls of all sizes and weights quoits bowling ping pong crokinoh billiards, werring knitting rone splicin, mikin, knot, the use of tools such as seissors born. hammerin, m delin, han ne bookbinding saddlers and shoemakin.

# LOBEL EXTERNITY

1 Circumduction of the Ankle (1 in 1) -The pittint sits with his foot strapped in place. The rule of miscment is regulated by a thumb

serew on the crink The handle is turned by the patient or operator for this stretchin, movement which should precede the voluntury active movements of the ankle

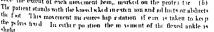
2 Inversion and Eversion of Foot (Fig 10) -(a) The patient wills on the inversion rule a definite di tince with hand cul support (b) ditto for eversion

3 Doraifiexion of Ankle-The principle sits or stands with his foot strapped to the footpiece Flor the ankle rusin, the weight The extent of the movement may be estimated by the number of clicks the creet measurement noted on the protractor and the total work done is early calculated

4 Rotation of the Knee - (a) Latient is cated with the feat strapped to the footpiece and the or abducts the foot rotating the

shght

leg against the brice He addines to 10-Inventor and Evension Boards. knee the extent of each movement bein, marked on the protri for (b)



5 Knee Flexion and Extension (Fig. ) -Triplicate machine Exercise I Face to the machine trap the foot to the floor attach ment Movement I lex the knee again t resistance.

10 Shoulder Rotation—Group the floor bundle the about on a bracket, shoulder high, the fore time fleved to a right angle. Pull up with the hand, throughout whole rung, of shoulder movement without ching up, the healt of the close or its angle of fix non.

11 Flexion and Extension of Shoulder Joint—(a) The patient stands with his back to the floor hundle the arm down and strught. Arm forward, ruse and lower (b) Face to the floor handle, draw the arm

back, and lower to position

12 Adduction and Abduction of the Shoulder—The patient studs with the side to the triplicate machine, shoulder utachment, arm and cord in line (a) bring the irm forward across the class (b) Patient studs

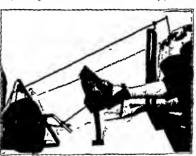


FIG 9-CIRCUMPLETION OF ANKLE

as in Pecceise 1 but using the floor attachment. Bring the strught of muphard and lower to position. (c) Patient stands with his side to the machine overhead attachment arm in line with the cord. Bring the sime downward and forward then downward and bickward alternately. (d) Patient struds with the side from the machine, the arm across chest, grisping the shoulder attachment. Extend the forearm and arm, keeping, them at the shoulder lord.

13 Passive Abduction of Shoulder—Patient standing with the side to the excepting board and the forearm rigidly extended. Climb up the board by the fingers with a struight arm and note. (a) the highest point at which the fingers can be lifted from the board by the patient, (b) the livel to which the patient can bring up his arm, without bending his elbow.

Exercise 1 Side to the machine, the foot strapped to the floor attachment Movement Adduct the thigh, keeping the knee straight Side from the machine foot strapped to the floor attach Exercise 2

ment Movement Abduct the thigh, keeping the knee straight.

7 Hip flexion and extension

Exercise 1 Face to the machine, foot strapped to the floor attachment Movement I xtend the thigh with the leg stretched

Exercise 2 Face from the machine foot strapped to the floor attachment. Morement Flex the thuh, Leeping the knee strught

8 Thigh flexion knee flexion foot dorsiflexion -Pitient teps through the rungs of a horizontal ladder with parallel bar arm rests The ladder is made admist able for height at one end and rai od to increase the movement required to rai e the foot over each run. This is estecially useful for leg amputation eases

9 Thigh extension knee extension foot plantar flex an increasing load of distance

or friction (Fig (11) Mensuration - Bofore

starting exerci e it is well to

know the range of motion pre ent at a junt so that comparison may be made after a short period of treatment to see whether or not improvement in range of motion is taking place. Under too active exercit or in those ca es where the muscles under active prome even is an strained further limitation of motion may be detected

Several sample devices have been devised consisting of jointed arms with a protractor scale one arm Is ing fixed at zero on the scale and the other movable about the protractor indicating in degrees as it moves the are through which it preses. This simple form a mo t neeful in measuring the range of motion in the joints of the extremities. In some of



IOR The hievele trains a with Fig. 13 -ONE TYPE OF PROTRACTOR SCALE TO MEAN THE HANGE OF MOTION One arm remains ats tion ry t zero th other arm free A doub! protractor scale facilital a th taking of mean prement on the two sid s of th body

Exercise 2 Face from the machine, strap the foot to the floor attach ment, the fleved leg and cord in the same line Movement Extend the knee against resistance



Fig. 11 - STATIONARY BICYCLE. Thigh and knee extension plantar flexion of foot

6 Hip Adduction and Abduction -Triplicate machine



FIG 12—GRIF MACHINE FOR IMPROVING FLEXION OF THE FINGERS AND REXION AND EXTENSION OF THE WRIST

which fits between the finars. The runts are underted with a pencil by dots on the calluland an both full flexion and full extension. The hand is they removed from the in trument, the dots connected by straight lines and this true posed to permanent record. This is illustrated by the Rosen apparatus in Laure 14

To appreciate the limitation in range of motion in the joint at is well to have at hand the normal mean range through which a joint moves The following table shows the normal range usually present in joints of the extremity

Wrist Joint

Flyton to 100 degrees Fytension to 40 degrees hang -- 140 degrees

Alduction-zero to is decrees I anne decrees

Addingtion-zero to ... decrees Range-at I grees

Ilbay Joint

Flexion to 45 d grees. Exten i n to 150 legrees. Pange-135 degrees

I ronation-zero to 30 degrees Pange-30 degrees Surmation-zero to 90 degrees Lange-30 learnes

Shoul ler Joint

Al luction-zero to 160 d'arce hange-100 degrees

(Note -- From sero to 80 d green is the rang in the shoulder joint it elf while from 80 to 160 dear es mos on at is mad by elevation and rotation of the seppula )

Flynon-zero to 180 degrees I ange-150 degree

I stin ion—zero to 40 il gr in Pang —40 d gr v.
Int rnal rotation—zero to 80 d g v. Range—10 d grees

Fat rull rotation-zero t to lar e ling - I krees linkk leint

Dir iffexing-90 il green to 1 dare w lange-4 i d grees

Hintar flixin-Jodgre 1 Odgres I mge- 0 dgres

(Note -Inversion and every n f the first cannot be men used with these simile in truments ) hne Jour

H vion to 40 darrees battensi n t 100 harrees I sugge-11 degrees IIm Joint

At lu tion-rero to 40 degrees large-4 degrees

Alluction-zero to 4 degree hange-4 legrees

Physion to 10 degre w Faten ion 1 180 legrees hange-190 d grees Hypercaten ion from 180 larger I at n ion to 11 larger langed arees

Faternal rotation-2 to to 60 1 price. Lange-60 digrees.

Internal rotation-zero to 30 depret I inge- 0 l'arces

# INDICATION AND CONTRACTORS

Indications - Congrular Levereres or indicated in these of edentary occupation wherein the general metalsih in has fall it below its nermal the hold and is evilening it If Is di turbance in one or m is of the systems compressed the I wis In purely systems diseases such as in e mpen ated chronic end scarditis or enterept > 1 a rationally applied



th 14-Posey Type of telegate i for lydicities Rasse of Monos at the Versiones and kneedeel forces



FIT TO -DYNAMOUSTER FOR MEASURING CRIP OF

the construments the protection scale register from 8 to 190 while in others it resters from 9 to 300. The accompanying photograph if in true one type of 100 ecocors, with another such frequential interesters with a contract of the body (1), 231.

It has been found that the uncasaring of huger motions with the protrictor scale of tees sum difficulties so that is sumpler fotan of pressuring apparatus was decread to plot out the untual range of more than on the meta-prophetic particle of a smill would not be consisted of a smill would not be consisted for a full foreign of the recovery of the dorsam of the recovery of the consistency of the tees the latest at the following the

which fits between the fingers. The joints are indicated with a pencil by plots on the  $\alpha$ -linked on both full fixion and full extension. The hand is their removed from the instrument the dots connected by straight lines and this transposed to perminent  $r_{tr}$  and  $T_{tr}$  thus is illustrated by the Rosen instartion in Figure 14.

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the extremity

Wrist joint

Flytion to 100 d grees | Intension t 240 degrees | Range-140 degrees

M Inctim-zero to so digrees I ange-3 larces

Adduction-zero to 0 degrees Issue, o degrees.

Flixi n to 4 d aries Lyten ion to 150 degrees I ange-135 degrees

I ronation—zero to 90 degrees Range—90 degrees
Suppration—zero to 30 degrees Rang —90 degrees

Shoul ler Joint

Ab luction-zero to 160 d grees 1 am -100 degree-

(Not -From zero to 80 d gress is the range if the bouller joint it elf while from 90 to 100 degress mo can nt i mad by elevati it and r tation

of the carula)

Flore m-zero to 180 d grees 1 ange-150 legree

Fyten i n-zero to 4 d gr es P ni -45 k-rees Internal rotation-zero to 80 k-re Raus -90 d sect

1 xternal rotation—zero to 45 degre * Range—i 1 grees

Ankle Joint

Dir ifferim-00 degr s to 1 d rees Pinte-1 degrees Hinter ff vin-30 d grees t 0 kpress Lange-20 d'yrees

(Note -Inversion and extrem f the fact annot I measured with these simple instruments)

Flexion to 4 direct Prient n t 180 ikgrees Range-13 digrees. Him Joint

Il lu tion-zero to 4 decrees l'expendo lecrees

Alluction-zero to 45 I gr ( Range-4 legre s Fixon t) 60 degrees Fixon to 10 legrees Punge-190 degrees

Fxternal rotation—zer t > 00 | pr ex Rang = 00 | lexteen Internal rotation—zero to 30 d pr ex lun ge = 0 | 1 x rees

## INDICATIONS AND CONTRAINDREATIONS

Indications—Gineralized event sam indicated in the coffeednment occupation wherein the general metabolism has fallen below its normal the hold and is cruth-neing it. If Is disturbances in one or more of the systems compute in, the lisk. In part has those do car such as in componited the new indicated within or natroptism a rationally applied.

general system of graduated exercises will accomplish more than any other form of therapeusis Again, in the functional neurological conditions so often grouped under the vague term of "neurasthenia," general ized exercise, by increasing the general metabolism and possibly by stimu lating the organs of internal secretion, is frequently markedly beneficial

The local indications for exercise consist in the limitation of function of a part, whether it is a joint, tendon or organ. In the last, as may be represented by a retracted lung in a healing empyema, the exercise of that portion of the motor apparatus, namely the chest, secondarily acts locally upon the organ within Local circulatory derangements, atrophies and contractures can frequently be prevented as well as improved when presenting, by the early institution of exercise properly applied

Contra indications - The contra indications to exercise include all those conditions in which the raising of the basal metabolism is detri mental Inflammations of all kinds, advanced depleting disease, and new growths are definite contra indications to exercise Local, healing, in flammatory disorders, by increasing the local metabolic changes, hasten, rather than retard improvement. However, although this is true, care must be exercised in the election of the time when exercise will not promote an extension of the inflammator, process A short list of suitable cases follows, arranged as to the indications requiring local or general exercises

1 Requiring General Exercise

Constinution

Litte roptosis

Gastric or intestinal neurosis

Chronic passive congestion

Marked compensated cardiae valvular disease

Compensated myocarditis

Arterial hypertension

Arterial hypotension

Atelectans

Postoperative empyemas Chronic pleuritic adhesions

Neurasthenia

Hysteria

Requiring Local Exercise

Torticollis, congenital and spasmodie Fractures, following reduction

Dislocations, following reduction

Amputations postoperative

Ankylosis, fibrous

Arthritis, chronic

Contractures, cicatricial, muscular or tendinous.

Peduced epiphyscal separations

Foot affection

Weak feet

Congenital or acquired club-foot following correction Metatarsulais

Sprains

Scolioses

Pegenerating peripheral nerve injuries

Paraplegias Heminlegias

Atamas

#### RFFF RF \CES

Arredson J Medical Gymnastics and Ma age J & A Churchill London, 1921

Poehm, Vas Massage Its Principles and Technic, W B Saunders

Company, Philadelphia and London 1913
Bucholz Manuel of Therapeutic May ago and Exercise, Lea. Philadel

phia, 1917 Frenkel H 5 Treatment of Taletic Atavis, Achinan, Ltd., London

1914

(rabam D) Massige 4th ed, Lippincott New York, 1913
Howell Thysology W B Saunders (ompute Philadelphia 1918)

Jones Dall took Orthopedie Surgers of Injuries, Oxford University

1 ress, London, 1921

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Injuries to Ioints Henry Fronds and Hodder & Stoughton, Lo

Alcen Fmil 1 Massage and Medical Camura tie 2d ed Wood & Com pair New York

McKenzie, K. Tait Leelinmin, the Manned Macmillan, New York

Vissen Practical Ma 16t and Corrective I xereises 4th ed , F A. Davis

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1 Requiring General Exercise

Constipation

Futeroptosis

Chronic passive congestion

Marked compensated cardiac valvular disease

Compensated myocarditis

Arterial hypertension

Arterial hypotension

Atelectasis

Postoperative empyemas

Chronic pleuritic adhesions Neurasthenia

Neurasthen

Hysteria

2 Requiring Local Exercise

Torticollis, congenital and spasmodic

Tractures, following reduction

Dislocations, following reduction Amputations, postoperative

Ankylosis, fibrous

Arthritis, chronic

Contractures, cicatricial, muscular or tendinous

the eighteenth century references are made indicating that it was even then appreciated that or expation was of definite value in neutrop relutative cases. Binjumin I ash, in 1801 in speaking of methods of treatment for nervous disorders ashto ited teaching, the roots of the mechanical arts in 1822, Dr. Winnia, Suprintendent of Vele on II op that strated that amusoments provided in the establishments for hundres such as che s bickgammon, ninepinis savingin, sewin, wood gardening reading writing, music cete, afforded extres estable of body and mind and had a powerful effect in tranquilizing, breaking up lost, a secutions of day and indicing correct holists of thinkin, as well as acting. The annual reports of superintendents of many in the swims during the list him lind veris point out the same trend of thinght and are more or le manimous in their approval of work as a remedial agent in improving the physical well-being and composing the refer should conditions of the patterns.

It is interesting to note that the type of work selected durin, the early cars in issuing occupation as a circular agent consisted largely in agricultural lalon, cirpantry and drawing and painting. Later the diversarial occupations were made in of last is late at 18.18. By It How of the lows fixted Hu pital stated that no graviter diversity of emploiment no more methodical application of this form of treatment culd be repried then was done fifty evers also. However, during the pit fiftien or twenty year, also make the selection of suitable nork for the men on and bland but also in the principle of applying suitable occupation for the of sound mind but physically landscapped. In 1916 Involed Occupation by Singin B Tray apply ared showing the value of occupation for the sick with lessons in creasing the resourcefulnes of the nurse in keeping a patiant excipated during allows in 1914 the Massachu tixt Circal Hospital citibished a melical workshap as a hospital department for the u c of the necessary of the property of the meanifecture of cannot flower lost gasts sundrile griden accessors and during its first year made of old self-self-supporting.

At Sharin Connection a convals cont bone for cardine cases was started where connect work, under to their door in Ma tehn exist Circial Heightal was made the work being graded as that molerate and controlled receives for the patent could be given and at the some training probability couplition affinded. In Ma wheatt the concernment and old bround to the concernment and old bround to the concernment was the chief removing and preved to many that through the agency of work made could be due.

During the list ten years in mins he pitals for chronic conditions such as the real is orthogs he he in a and circles do in a and in innum

Quelet milbert m

## CHAPTER VII

### OCCUPATIONAL THERAPY

# WILLIAM V HEALEY

Introduction—For many years medical men have realized that prolonged illness or disability, particularly in patients requiring prolonged hospitulaxition, was fraquently recomputed by a mentally depressed or lethargic state, which was rarely overcome until the patient was able to return to his former occupation, or at least some occupation. It wis not an uncommon eight, ten veras 190, in entering, a hospital ward, to see twenty or more patients, in ill stages of illness, either lying quietly in bed grains, at the rivial blink hospital walls, or sitting up aimlessly, or easionally reading but for the most part doing nothing. Airies, at times noting certain patients more depressed than others, would give them heaps of cut give to fold and thus aimple measure frequently transformed a much worried and depressed individual, lying disgranded in bed, into a more or less cheefful one, sitting up in bed and, while work and, talking to his neighbor.

ng, taking to his neighbor. A few thoughtful persons prior to this time, with keen insight into the psychology of the suk, advocated keeping hospital patients bus. They appreciated, of course, that the c seriously ill or in a critical condition could do no work, but the large percenting of hospital patients during their stay in the hospital frequently spent two-thirds of their time in a more or less convolvement condition, which time they could improve by suitable work, thereby not only improving themselves physically but psychologically preparing themselves for their return to their former or other occupations. For many years occupations of various sorts have been sought for the blind and for those suffering from mental disorders, and the beneficial effects in these types of cases hive been too well recommed to require more than passing comment. But it has been the work accomplished by these types of cases that has done so much toward the establishment of the idea that occupation is one of the best means we have for adopt in the recovery of the sick or manned

Manual work has been well recognized for many years as a therapentic agent in the treatment of mental diseases. In the medical literature of rehabilitation of those applying for such assistance. This law was passed by Congress in June, 1920, and is known as the "Industrial Rehabilita tion Pill' Up to the present time thirty four tries in the Union have accepted the offer of Congres and have appropriated varying sums for the rehabilitation of those erappled by accident or disease, making it possible for any individual to receive the required training to fit him for work that he can do In \cu \text{\text{orl} \text{\text{state}} the appropriation of \$7,,000, with a like sum received from the Federal Government provides the means with which physically handicapped persons may receive vocational train ing to fit them to return to some occupation—the only limitations being in those eases of aged or helpless individuals, the e confined in penal in stitutions, epileptics, feeble-minded and the e na ler the age of fourteen The rehabilitation work is carried on under a Commission consisting of a Commissioner of Education a m mb r of the State Indu trial Commis sion and the State Commi sioner of Health

To-day one hears many terms used in conjunction with the care of the sick and maimed other than medical. Occupational therapy ergo therapy, functional resducational reliabilitation therapy vocational train ing and rehabilitation curative occupation and countless others, all of which border upon and merge into each other set differ from each other in the stage of illnes at which they are utilized and the minuter in which they are applied. In order that we may adequately understand the principle of this type of therapy we should clearly define what is meant by the term occupational therapy and by the a sociated terms abovementioned

Occupation is work. Work used to improve either the ply ical or men tal functions of a patient is occupational therapy. Ergo therapy is work

therapy and lience synonymons with occupation therapy

Functional reducation as ned in commetton with retoration of those thysically manned as the play real re toration of function by means of appropriate phy totherapy uch as biking hidritherapy may uge electricity or gymnastics. Where a remedial exercic is given in the curative work hop through the movements required in carrying out definite trades or occupations, this type of work bard is closely upon occupational therapy In a monograph on Occupational Therapy Applied to the Lestoration of Function of the Disabled Joints Baldwin states that occupational therapy is based on the principle that the be t type of remedial exercise is that which requires a cries of specific voluntary movem nis involved in the ordinary trades and occupitions physical training play or the daily return activities of life. In this the anthor ha limited occupitional work to those suffering from disabled joint but a broader conception of its usefulness must be appreciated. Functional reclucation of applied to the restoration of di alled junts and accompli hed through the medium of exercic in the curative work hope is certainly occupational

erable private and semiprivate sanitariums, occupational therapy, through awakening the will and affording encouragement, has aided greatly in shortening the time of convalescence and the maintenance of the spirit of accomplishment

The stimilis of the War brought out the usefulness of this remedial agent very forcibly, when those previously active in private life were said donly brought into hospital environment so maimed that, in many cases, prolonged hospital convale-scence confronted them. I do not doubt that, had no definite plan of occupation been outlined for them, they would have evolved a means of their own to keep themselves occupied. Prolonged hospitalization without some sort of occupation is demoralizing. The cinius seen in everyday life among those with insufficient or uninteresting occupation is migrafied in those of unsound body who cannot seek the diversions available for those sound in body. The establishment of occupational work throughout the army hospitals did much for the mainternance of the morale of the patients.

At the W-liter Reed Hospital, where curative workshops were established under the direction of Major Bird T Baldwin, the effort to utilize occupation as a definite means in the restoration of disabled function was successfully accomplished. The movements required in special type of work were carefully studied and patients locking function in one or more joints were put to work at occupations requiring these very movements. For example, in limitation of pronation and supnation in the forearm, no better form of everiese could be given than the use of the screw driver in doing electrical work, which at the same time affords interesting and instructive computing for the roles.

interesting and instructive occupation for the patient. In New York City, the Ricd Cross Institute for Crippled and Disabled Men, founded through the generosity of Mr. Jeremah Milbank, opened up a new sphere of action, and has developed into a model in stitution for the rehabilitation of the crippled and disabled. This In stitute aims to train vocationally the patient around his handicap, so that in spite of his physical infirmatics he may become partially, if not wholly, self supporting. The Institute affords a school wherein those receiving out patient hospital treatment may be trained during, their period of disability for one or more hours during the day, so that, by the time they have reached the maximum physical improvement, they will be ready to take up suitable gainful occupations.

Recently the Federal Government, appreciating the dire need of such necessary reducation for the erippled or disabled, has appropriated a fund whereby the individual States upon appropriation of a sum of money, will receive a like sum from the Federal Government for the vocational rebablitation of those disabled through accident or disease. In each state there has been appointed a State Commissioner for Vocational Rehablitation, whose duty it is to spend these appropriations in the vocational

relabilitation of those applying for such assistance. This law was passed by Congress in June, 1920, and is known as the 'Industrial Reliabilita in Bill'. Up to the present time thirty four states in the Union have accepted the offer of Congress and have appropriated varying sums for the reliabilitation of those employed by accedent or dease making it possible for any individual to receive the required training to fit him for work that he can do. In New York State the appropriation of \$75,000 with a like sum received from the Federal Government provides the means with which physically handly apped persons may receive vocational train go foff them to return to some occupiton—the only limitations being in those cases of aged or helpless individuals tho econfined in penal in situations, epileptics feeble-minded and those under the age of fourteen. The rehabilitation work is carried on under a Commission constitug of a Commissioner of Education, a member of the State Industrial Commission and the State Commissioner of Health.

Today one hears many terms used in conjunction with the care of the sick and maimed other than medical. Occupational therapy ergor therapy functional recludeational rehabilitation therapy vocational training and rehabilitation curative occupation and countless others all of which border upon and merge into each other yet differ from each other in the stage of illnes at which they are utilized and the mainner in which they are applied. In order that we man adequately understind the prinruple of this type of therapy we should clearly define what is meant by the term occupational therapy and by the a sociated terms abovementioned.

Occupation is work. Work used to improve either the physical ir mental functions of a patient is occupational therapy. I rgo therapy is work therapy and hence synonymous with occupation therapy.

Functional recducation, as u of in conjunction with restoration of those physically natured is the physical restriction of function by means of appropriate physiotherapy, such as biding hadrotherapy in a single electricity or genusatics. Where a remodul exercise is given in the curative workshop through the movements required in currying out definite trades or occupations this type of work borders closely upon occupational therapy in a monograph on Occupational Therapy I pipited to the Let entrain of Function of the Disability Joints Baldwin states that occupational therapy is a la ed on the principle that the best type of renderful exercise is that which requires a series of specific columners movements involved in the whole requires as series of specific columners movements involved in the admans trades and occupations physical training, play or the data readmans trades and occupations physical training, play or the data readman settices of life. In this the author has hunted occupational first the folius of its net folius of interful points and accomplished through the medium of exercise in the curature with clopes is contained computational many computational computational computations.

therapy, for not only does the patient functionally improve the range of motion in his joints, but he receives a training in mental coordination which, if anythin, is of more permanent value than the physical restora However, there are miny eases totally unsuited for work in the curative workshops which can be reached and benefited by occupation appropriately applied

Achabilitation theraps, is its name implies, may include both the physical rehabilitation and the vocational rehabilitation, and for this reason is a rather confusing term Vocational rehabilitation, or voca tional training, is the training of one physically or mentally k-low pir, Physical rehabilitation on the other hand, includes all the medical, sur gierl and physiather spentic means for the restoration of function in a patient and should not be confused with occupational therapy

If one appreciates that occupational therapy is applied to those chronically ill or maimed, as an adjunct in improving their physical and mental well being while disabled, either by means of curative workshops or by less active work it looms or in bed, and that the advancement made is the patient improves physically is in the taking up of vocational train ing and fitting hum for smitable work as a means of carning a livelihood a more definite understanding of the principle and purpose of occupational therapy will be obtained

The selection of work suitable for a patient may vary from the cutting of paper puzzles in bed to the use of the electric torch in acctilence. welding but it is nevertheless, work, requiring a varying degree of mental and physical coordination on the part of the patient, and it is the beginning of the training in mental or physical coordination that dig-nifics the work accomplished as occupational therapy

#### TYPES OF REMEDIAL WORK

Work, as a remedial agent, varies in the type of case in which it is used, as well as in the stage at which it is started. One might divide such work into three stores, as follows

- 1 Occupation for those bedridden
- 2 The intermediary stage, or occupation for ambulitory cases requiring hospitalization
  - 3 Vocational training

Among the bedridden it is generally understood that those acutely ill require rest and are not benefited in any way by ittempts at even diver sional occupation But there are many bedridden patients among chronic cardiacs, tuberculous cases and hopeless cripples, interested in work which they are able to do and which stimulates and endows them with a spirit



FIG. 1 -PARE ANITHMS AND TAPESTRY MANING.

of hopefulness and of accomplishment that can be gained in no other way. The dissatisfaction of being unoccupied in bed offers time for



thought and introspection and complaint concerning the unfortunates condition. The improvement in the powers of coordination the less ening of the intro pection and the requirement of fixing the attention to the

therapy, for not only does the patent functionally improve the range of motion in bis joints, but he receives a training in mental coordination which, if anything, is of more perminent value then the physical retoration. However, there are many esses totally mismited for work in the curative workshops which can be reached and benefited by occupation proportionally applied.

Rehabilitation therips, is its name implies, may include both the physical rehabilitation and for this reason is a rither confusing term. Vocational rehabilitation, and for this reason is a rither confusing term. Vocational radiabilitation, or vocational training, is the training of one physically or mentally below per in work by means of which he will later be able to make his hydrhood Physical reliabilitation, on the other hand, includes all the midical, sar girell and physiotherapeutic means for the restoration of function in a patient and should not be confused with occupational therips.

patient and should not be confused with occupational therapy.

If one appreciates that occupational therapy is applied to those

If one uppreciates that occupational therapy is applied to these chromeally all or manned, as an adjunct in improving their physical and mental well being while disabled either by mens of curitive workshops or by less active work at looms or in bed and that the advincement made is the princip improves physically is in the taking up of vocational training and fitting him for suitable work is a means of carning a livelihood a more definite indirectivating of the principle and purpose of occupational therapy will be obtained.

The selection of work suitable for a patient may vary from the cutting of paper puzzles in bed to the use of the electric terch in acetylene welding but it is, nevertheless, work, requiring a varying degree of mental and physical coordination on the part of the patient, and it is the beginning of the triuning in mental or physical coordination that dig

nifics the work accomplished as occupational therapy

## TYPES OF REMEDIAL WORK

Work, as a remedial agent varies in the type of case in which it is used, as well as in the stage at which it is started. One might divide such work into three stages, as follows.

1 Occupation for those bedridden

2 The intermediary stage or occupation for ambulatory cases requiring hospitalization

3 Vocational training

Among the bedridden it is generally understood that those acutely ill require rest and are not benefited in any way by attempts at even diversional occupation. But there are many bedridden patients among chronic cardiacs, tuberculous cases and hopeless cripples, interested in work which they are able to do and which stimulates and endows them with a spirit



FIG 4 -BRAIDING PLGS WHILE CONTALESCING

The intermediary stage comprising by far the greatest number of patients who are benefited most by suitable occupation, includes that large



FIG 5-WEAVING ON HAND LOOMS IN THE WARD

class of patients requiring institutional treatment but not actually confined to bed. In every surgical ward in many medical wards in all orthopedic institutions or service and in convalencent and tuberculous

work at hand engenders an unproved spirit with the desire of accomplishment in those kipt occupied. Suitable occupation requires thought in selection. The previous mental status of the priticit, his age presenply sucal condition, likes and distilkes and personality must be considered, but once a suitable nurse is found, the effect produced will warrant be



FIG 3-BARKET MAKING MINIEF CONFINED TO A WHEEL CHAIR

effort spent in finding it. Tollowing is a short list of occupations suitable for those confined to bed

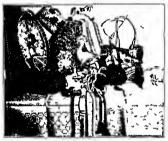
Puzzles
Chip carving
Modeling
Making flowers
basketrs
Crocheting
Knitting
Belt making
Small loom work

Metal work
I either work
Drawing
Dest_ming
Painting
Imbroidering
Reading
School work

Stenesł work

finger, to the blacksmith's sledge so that ordering work with the use of a hammer would be as ill advised as the prescribing of a tonic, and leaving it to the patient to administer to himself any stimulant he might think necessary

At times patients will re ent doing the diversional forms of occupation, and will respond admirably to the stimulus of curative workshop occupation when it has been explained to them that the u e of certain tools or machines, when used as directed, will help the stiffened hand or weak and leg. Most patients however respond to the creative idea of producing something, and once they can be interested in the production of an



F c 8 - Scarff Table Covers Bashers Toys Fre Products of Occupational Therapy

article it is difficult to draw them away from it until it is fin hed. They must be ctrefully watched as patients recently out of bed will often fatigue themselves at the biginning of their work, so that it is very difficult to get them to return to it. Want forms of occupition have been made applicable to this class of cises and the more experience the director of this work, has the greater divirsits of occupations he will find suitable for them.

The space allotted to the work within the confines of bospitals varies in different institutions from the equipment that may be kept in a ward to whole buildings of curatine workshops but the same principle of sus tained effort may be secured from the humblest equipment as from the most elaborate.

Occupations for ambulatory cases may be selected from the following



FIG 6-PUG AND TABLE COVER WEAVING AND PAINTING FOR AMBULATORY CASE

homes, great numbers of patients are to be found who respond admirably to the stimulus of work. The choice of a suitable occupation for these



I to 7 -Jig saw Wort for Ambut Story Cases

people is extremely important. As Barton has pointed out, a hammer may vary from the small jewelers hammer which may be strapped to a

finger, to the blacksmith's sledge so that ordering work with the use of a hammer would be as ill advised as the prescribing of a tonic, and leaving it to the patient to administer to him elf any stimulant he might think nece sary

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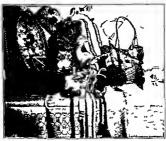


FIG 8-SCARES TABLE COLER B4 MET TOYS ETC PRODUCTS OF OCCUPATIONAL TREENEY

article, it is difficult to draw them away from it until it is finished. They must be carefully watched, as patients recently out of bed will often fatigue themselves at the beginning of their work so that it is very difficult to get them to return to it. Many forms of occupation have been mode applicable to this class of eace and the more experience the director of this work, his, the greater diversity of occupations he will find suitable for them.

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Occupations for ambulatory cases may be selected from the following

list which have been found suitable in many different institutions utilizing occupation as a remedial agent

Loom work (making small blankets, rugs, table-covers, searfs, bags, etc )

Basketry

Cabinet making Bookbinding Leather work

Hammered bress work

Pottery Cement work Light gardening

Salmon gives the following as equipment for the beginning of a cura tive workshop

Smith shop

Forces tools etc for 10 men

Fitting shop

1 screw cutting lathe 1 sensitive drill

1 polishing machine 1 electric motor (11/ horse power)

Swages and tools for 8 men Leather blocking

Sewing machine Eyeletting machine Galvanized iron and tools

Tailor's shop 3 sewing machines Tools for 10 men

Carpenter shop

Selected tools for 15 men Bench screws

Jewelry work

Special tools not for general use Woodturner's lathe

Machine shop Electric motor (814 horse power)

Shafting Brackets etc Cement shop

Metal molds Tools for 12 men General Drilling machine Grandstone

Screw cutting lathe Fret saw workers machine and

natterns Circular saw bench

When a patient, physically handicapped through accident or disease is forced to abandon the thought of return to his previous occupation, he is faced with the problem of finding some work which he will be able to do Ordinarily this would mean either working for a lower wage or for less time, either of which would mean a decreased income, lower standards of living and discontent. All who have seen patients pass through this change realize the marked psychological change such individuals undergo, and yet there are but few for whom profitable productive occupation cannot be found, if they are able to get about and still possess the desire to work

To do this, the problem of vocational training must be started in the hospital Occupational the rapy, used intelligently, instills into the patient the necessity for continuance of productive activity and prepares the way for vocational training The standardization of equipment, the selection

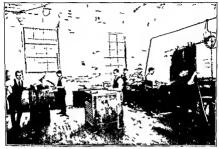


Fig. 9—Printing Shop at the Dover Farms Industries New York Where Voca tional Training Rehabilitates the Crippled and Disarles



FIG. 10 -FLT SHUTTLE HAND LOOMS AT THE DOVER FARMS INDUSTRIES NEW YORK.

of standard design, used during the ambulatory stage, will do much to shorten the preparatory les ons in a vocational school

Institutions like the Red Cross Institute for Crippled and Disabled men and the Dover Farms Industries in New York, are to-day practically solving the vocational problems of hundreds of physically handicepped men. The former institution, after a thorough study of many occupations, aims to truin the bandicapped individual in an occupation sinted to his requirement, whereby his handicap is minimized. The Dover Farms In dustries maintain a city center, where the hindicapped are trained in productive occupations, paying the individual on production. They also



Fig. 11 -Rig Maring at the Dover Farms Industries Three cases of amputation of extremities are shown

maintum a farm where handicapped men may be kept for an indefinite period where weekly sigos remunerate the individuals efforts in congenual surroundings. Whether the method of redundational problem in the method of grouping the handicapped in a community and having the total production provide a livelihood for each member of the community is the better, can only be found by meeting each individuals problem in the most sensible way so as to permit of time's economic ad justiment of the problem.

Application of Work—The most important factor in the application of this form of work lies in the qualifications of the director of occupational therapy. Such a director must possess a deep interest in this

subject in order that he may be able to arouse the interest of his patients. The suggestion by a tretless director that it is time for a convale-cent pittent to go to work frequently arouses an antagonism on the part of the patient against any form of occupation which is difficult to overcome. On the other hand, the more versitile, tactful director will fit interest himself in the patient's everyday psychology, finding out his likes and distilks and having become somewhat acquainted with him suggest that they do something, together—the most reasonable approach and one most frequently assented to by the prittent

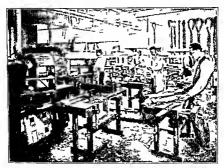


Fig 1 - Cocational Periabilitation at the Pover Farms Industries Cabinet Shop

The type of patients in the orthopedic hospitals differs insternally from that found in hospitals for mental discusses and the approach to a patient in each instance will vary. The more certaintee the director the easier it will be for him to suggest an occupation suitable to the patients requirements. It is as burnful to strit a patient on a piece of work that is difficult for him as it is to order an overdors of strebinn. The director should moreover, hossess an unbounded patience a visit amount of energy, an appreciation for effort even in such cases where the product of the patient's efforts is hoppless from a commercial point of view. The accomplishment of producing even a poor's made article where the of fort is appreciated frequentity will stimulate the patient to further effort

and awaken an interest in the work which grows into a desire to return to regular occupation

The application of occupation requires time, of which the average consulescent, or chromerlly ill patient, has an abundance. It is time in which the nationt is wealths, and whereas commercial articles to be salable must be turned out in the greatest of numbers in the shortest space of time. the product of the occupational theraps department should be one whom value is based on its excellence of work in order to connecte with the commercial market \ well-done piece of hand hammered brass has a market which cannot be infringed upon by the machine-mide article, and the monetary value of such an article is measured only by its excellent It is important, therefore, that

1 Useful articles be produced

2 Articles be produced for which a market exists

3 I'ffort is made to produce articles which, because of their ex

cellent workmanship, form and color, are to be commended

The space required for the application of the work will vary second ing to the type of institution in which it is used. Whereas, in the taker culous hospitals much of the work will be done in bed, the requirement for space, other than for small storage rooms, is not great House, in the orthopedic institutions or in the general hospital or surgical services, the curative workshops require space for small machinery, for large looms and for different types of work which cannot be dispensed with I small beginning usually leads to more extensive plans than were formerly thought of so that, in beginning such a department, sufficient space should be allowed for natural development. In the Reconstruction Respital in Now York, where industrial accidents and diseases are cared for, one cutire floor of an eleven-story building, non in the course of construction, is to be devoted entirely to occupational therapy

The innancing of a department of this kind is frequently one of the objections raised in starting such work. Like all other departments of a hospital, it requires money to run it Some institutions have appropriated a small sum to start the work, placing in charge of the department an experienced occupational teacher who works under the direction of a medical adviser As assistants to the teacher, volunteer aids can be secured, who will give part of their time to the teaching of the different crafts. As products materialize in the department, the assistants dispoof them through sales, buzaars or through commercial houses, who sell the articles on a commission basis. The cost of the material is deducted from the selling price, the patient receiving the balance for his work. In other institutions, the patient makes one article which he is permitted to sell for humself on condition that he produces another like article for sale by the institution Still other institutions have a fixed price, which is given for the work produced, the institution disposing of all articles

at its own price. The choice of method of disposition of the articles is, however, not the most important phase of the work and is usually met with in some way by the director of the department. The effect, how ever, on the patient of securing monetary return for his efforts cannot be dispensed with, and, to my mind is an important factor in readjust ing him and hastening his return to more profitable employment.

The National Society for Promotion of Occupational Therapy has re-

1 Occupational Therapy is a method of treating the sick or injured by

means of instruction and employment—productive occupation

The objects are to arouse interest courage and confidence exercise mind and body in healthful activity overcome functional dissultity and reestablish

capacity for industrial and aocial usefulness
3 In applying occupational therapy system and precision are as important

3 In applying occupational therapy system and precisi in other forms of treatment

33 in other forms of treatment 4 The treatment should be administered under constant medical advice

and supervision correlated with other treatment of the patient.

Treatment should in each case be specifically directed to the individual a

needs

6 Although some patients do best alone employment in groups is usually
desirable because it provides ever ive in social adaptation and stimulating influ

ence of example and comment

7 The occupations selected should be within the range of the patient's esti

mated interests and capabilities

8 As the patient a strength and capability increase the type and extent of

occupation should be regulated and graded accordingly

O The only reliable measure of the value of treatment is the effect upon the patient

10 Inferior workmanship or employment in an occupation which would be trivial for the health; may be attended with the greatest benefit to the sick or injured. Standards of entirely normal persons must be maintained for the proper mental stimulation.

11 The production of a well made u eful and attractive article or the accomplishment of a useful task requires healthy exercise of mind and body gives the greatest savisfaction and thus produces the most beneficial effects.

Novelty variety individuality and utility of the products enhance the

value of an occupation as a treatment measure

13 Quality quantity and salability of the products may prove beneficial

13 Quality quantity and salability of the products may prove beneficial by satisfying an 1 simulating the patient but should never be permitted to obe ure the main purpo e

14 Gool craftsmanship and ability to instruct are the essential qualifications of the occupational therapsit Understanding interest in the patient and an optimistic cheerful outlook and mann r are equally essential.

15 Patients under treatment by means of occupation therapy should also engage in recreational or play activities. It is advisable that gramastics and calistilences which may be given for habit training abould be regarded as work. Social dancing and all recreation and play activities should be under the definite head of recreations.

Marvland P ychiatri Quarterly Janu ry 1919

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#### THAPTER VIII

#### FLECTROTHERAPY

# HAPPY EATON STEWART

### GALVANIC OR CONSTANT CURRENT

Sources —Galvanic electricity may be obtained from the town highting supply, which, if alternating in type, must be changed over by motor transformers. It may all o be derived from power generated on the premises or from the chemical action of scells or hatteries. Some one of these sources of cirrent is always never at hand

Apparatus—It has eamed to the writer that too much space has been given by authors on electrotherapeuties to a detailed description of appartition. The physician is now able to obtain a number of well-constructed types of gulvanic machine. The kiding minufacturers are providing service to keep such appartitis in working, condition therefore it nould seem that complisises should be placed upon the playsies play subgroup effects indications and technic rather than upon any detailed de cription of machine construction.

Physics - 1 very brief sketch of the physics involved in the galvanic current is necessary to the understanding of it physiological effects and will serve as a basis for the commechension of the other types of current The earth continus a certain amount of electricity, which amount is taken as the studard for compart on with the amount contained in other objects. An excess of that contained in the earth might be considered as in her potential or a positive charge and will flow to the earth when a lody so charged as connected to at by a conductor or ground and the flow will continue until the electrical charge of the body is count to that of the earth Plectricity will pass from a body charged with a higher potential to one with a lower potential when o connected until the charge in each is equal. When we do are this flow or current to be constant we must find some me ins of creating and maintaining a differ ence in potential. This may be accomplished through chemical action in the galvanic cell or by mechanical action in the dynamo. The simple t form of generating an electric current is in the single cell which will now be described

Galvanic Cell - This consists of a container partially filled with diluto sulphuric or hydrochloric acid termed the electrolyte, into which is placed a rod of zinc and a rod of cirbon or copper Chemical action is at once set up, the acid reacting upon the zine with the formation of new chemical substances, among them zine sulphate and hydrogen Some of these chanents travel toward one pole and some toward the other, according to their electrical affinity. So long as this chemical action of the acid on the zine pole continues, the principal movement of elements toward the carbon or copper pole is maintained, charging it with a higher potential, and it is therefore designated as the positive pole, the zinc be coming the negative If to these poles out ide of the cell a conducting wire is attached an electrical current will flow from the positive to the negative poles thus completing the circuit. Thus it is seen that the difference in potential within the cell constantly created by chemical action is equalized by the flow of current along the wire. When this chemical action becomes weaker or ceases, there is a corresponding weak ness and cessation of the current outside of the cell. The dry cells follow the same principle of construction except that the electrolyte is made of some solid or semisolid substance, and the container is of un breakablo matera il

Batteres — Io obtain more power than can be generated in a single cell two or more may be connected together to form what is known as a hattery. In medical practice we usually desire high voltage and low amperage, to obtain which, the cells must be connected in series. In this ca e the positive pole of one cell is connected with the negative pole of the next cell and so on to the deviced number. In this way the amperage remains that of one cell, but the voltage is multiplied by the number of cells connected. Occasionally, however, high amperage is desired rather than high voltage, the cells are then connected in parallel that is all the positive poles are joined together to form one terminal and all the negative to form the other.

Electrical Terms — The simplest definition of the virious terms met

with in studying this subject should be constantly kept in mind  $\,$  Among them are

Volt - The unit of pressure of electromotive force generated by the standard wet cell (V)

Ohm —The amount of resistance offered to the passage of a current

through one thousand feet of one tenth inch copper wire (R)

Ampere —The quantity of current which the force of one volt will drive through one olim in one second. Since in medicine we usually ded with resmill quantity of electricity, we commonly us one one-thousandth of this amount or the milliampere (m 1) is our standard.

Ohm's Lav -In an electric circuit the strength of the current is

inversely proportionate to the resistance. The quantity of current (ain pres) C, is equal to the electromative force (volts) E, divided by the resistance (ohms) R or C equil  $\frac{p}{R}$ . No more simple was can be found to illustrate these terms than be comparing the flow of electricity to that of water. Let us suppose that we have two containers connected by a pape each partially filled with water. If one is above the level of the other the water which shows through the paper represents the ampera, and the proportional and the quantity of water which slows through the paper represents the ampera, The speed or pressure of the flow would correspond to the volta, c, while, the resistance offered by the wills or turns in the paper is embles the obmago in an electric error.

It is stated in Chapter AII that the constant current is the one whose main effect is chemical. For all practical purposes the slight thermal effect can be dissignated. When the solit interior is particularly complete the current is particularly completed by the place. Complet molecules are dissented and new combinations formal from their elements. Atoms become electrically charged and the ions already in the tissues begin a movement across the electric hild or pulsavia ecocyling to their different affinities. As will be lates shown these chemical effects, produced by the privage of the galvanic current through the tissues are whit determine its employment in their apentus. They are complex and many of them relatively unimportant but the important and useful chemical changes may be need advantage or in the other disregarded.

Physiological Effects—The chemical changes just referred to may be brought about within the living body ulmost as easily as outside of it. It must be clear that we are it ling, with a powerful agent by means of with the offect tissue process. Indeed within its very evident limits tions we have the advantage of most afterst and more easily localized effect than 15 possil to with drugs by internal administration. Since, the long within the tissues do more easer diagnostic time. Since the long within the tissues do more easer diagnostic to the special possibility it into the selective polar affinity it into the evident that the selection of the proper pole is absoluted in most conditions where the application of the poutive pole is indicated the negative would be distinguished by the following the selective action of the colour pole upon drug upon will liter be taken up. The effects which they even thou have, testing the reservation of the colour pole in him, tissue are as follows.

# Positive pole

- 1 Produces visoconstriction i
- 2 Is seditive to ensory more endings, relieving pain
- 3 Hardens newly formed tissue especially se 11

Galvanic Cell -This consi ts of a container partially filled with dilute sulphurie or hydrochloric acid, termed the electrolyte, into which is placed a rod of zine and a rod of carbon or copper Chemical action is at once set up, the acid reacting upon the zine with the formation of new chemical sub tinees among them zine sulphate and hydrogen. Some of the e elements travel toward one pole and ome toward the other, according to their electrical affinity So long as this chemical action of the acid on the zine pole continues, the principal movement of elements toward the carbon or copper pole is maint ined chargin at with a higher potential and it is therefore designated as the positive pole, the zinc le coming the negative If to these poles out ide of the cell a conducting wire is attached, an electrical current will flow from the positive to the negative poles thus completing the circuit. Thus it is seen that the difference in potential within the cell constantly created by chemical action is consilized by the flow of current along the wire. When this chemical action becomes weaker or ceases, there is a corresponding weak ne s and cessation of the current outside of the cell. The dry cells follow the same principle of construction except that the electrolyte is made of some solul or some old substance and the continuer is of an breakable material

Batteries -To obtain more power than ein be generated in a single cell two or more may be connected together to form what is known as In medical practice we usually desire high voltage and low amperage to obtain which, the cells must be connected in series. In this case the politive pok of one cell is connected with the negative pole of the next cell and so on to the desired number. In this way the am perige remains that of one cell, but the voltage is multiplied by the number of cells connected Occasionally, however, high amperage is desired rather than high voltage, the cells are then connected in parallel that is, all the positive poles are joined together to form one terminal and all the mantives to form the other

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Ohm's Lau -In an electric circuit the strength of the current is

the positive pole. Certain complex productions are broken up by an electrolytic process and when dissociated the newly liberated ions also start a definite migration following the same principles.

New clements then formed have a modifying effect upon the tissue

During their passage through the ti sucs miny of these eliments are swept away in the blood and lymph channels through which they at tempt to make their way, and thus their elimination from the body is hastened Clinically the result of this process is sensed by the marked relief from fatigue in inv given locality after a few minutes application of the galvanic current. Pain is lessened by the sedative effect of the teady movement of certain ions in the vicinity of the sensory nerve endings those attracted to the positive pole predominating in this effect The slight tingling or stinging sensations that are produced when the galvanic current is applied are undoubtedly due to this fact. There is no doubt that the sudden starting of such some movement through the motor nerve endings causes the preliminary contraction, or twitch which the muscle rives when the galvanu circuit is closed or made. The steads movement of these ions when the current is kept at even strength does not can e any further mu ele contraction. When however the strength of the current is suddenly changed or the current is turned off there results another muscle twitch. Therefore we may assume that an order to produce a muscle contraction in the valuety of either pole it is necessary to bring about an abrupt starting or stopping of ionic movement. If the current is reversed very slowly, we obtain a response from the sensory nerse endings as the result of the movement of the ton fir t in one direction then in the other. When however this reversal is abrupt the ionic movement will result in a stimulation to the motor nerve endings and the muscle substance, which results in a contraction. The more rapid the reversal of polarity or the application and removal of the current becomes beyond the number of fifty or oper second which is physiological the less vigorous will be the muscle contriction responses. When these changes reach a frequency of approximately five handred per second no relaxation time is allowed and the muscle becomes tetanized we shall see in the study of high frequency currents when these changes are mereased to over ten thousand per second the ions remain practically stationary, there being more time for appreciable movement in either direction, and as we would expect all motor respon to on the part of the muscle cease from that point on As might be expected there is a difference in re pone to current

As might be expected there is a difference in re-poin et current variations at the two poles. At the re_non of the positive pile or anode there is a decrease in irritability and a k and contractile re-poins while at the negative pile or eithode the irritability is increased and the contraction more marked. The stimulation of the central necrous system may be brought about by a removal of the future, products in the

Negative pole

- 1 Produces vasadilatetion
  - 2 Is both stimulating and irritating
  - . Softens and reduces the amount of sear tissue

Polarity Tests—Fill a glass partially full of sult solution, a 1 or 2 per cent solution as ordinarily u ed on all galarone electrodes is sufficiently strong. The galarone electrodes is sufficiently strong. The galarone electrodes is sufficiently strong as moderate amount of current and allow the other tips of the two cords to drop into the solution about a half unch apart. Very soon laubiles will be seen on one of the metal tips. This is the negative pole. Another to t is to apply the cord tips to mostened pink limins paper, when a blue stain will appear at the negative pole. It should be remembered that units several types of wall plags, the polarity on the appuritus may be concerned that the sprinting solution is connected up to the current Where central contict plugs are used, or it is not necessare constantly to disconnect the machine, the terminals into which the cord tips are inserted may be permineutly marked as the polarity will not change.

The resistance of the human dry skin is about five thousand ohms,

The resistance of the human dry skin is about five thousand ohms, we moreten the skin with saline in order to reduce this resistance as much as possible

Therapeutic Uses of Galvanic Current —In therapeutic practice the alvanic current may be employed to

- 1 Introduce drugs into the tissues—so-called medical ionization 2 Relicve local or general frique by removing waste products through the rearrangement and redistribution of ions already in the tissues
- the rearrangement and redistribution of lons already in the tissues

  3 Dt troy tissue through the formation and concentration of caustic
  elements it the point of entrance or exit of the current—surgical ioniza
  - on
    4 Alleviate pain through sedative effect upon sensory nervo endings
- 5 Produce muscular contraction when n ed in its interrupted, wave or sinu oidal form
  - 6 Stimulate the central nervous system
- 7 Reduce the size of hypertrophic and adventitious tissue within certain definite limitations

The subjects of medical and surgical iomization will be taken up and divensed under their veparate headings. The relief of local and general futigue is accomplished in this manner. As soon as the galvanic current is passed through the tissues, there is at once instituted a movement of cert in of its elements or ions. Those carrying a positive charge move in the direction of the negative pole, while those negatively charged seek

uneen degree of monsture while thes still seem wet enough to reapply without soaking. When the small dise electrodes are used with a hosphike metal rim they are apt to become conceive and the pittent receive a concentration of current from the rim rather than from the whole electrode. They must be kept flat by cotton or a smitable covering of gainze. Where gauze is used as the covering not less than twelve to fifteen layers hould be applied. In the application of electrodes to pittents it is indivible to have plenty of absorbent cotton at hand. This may be cut into sizes slightly larger than the electrodes, well scaked in saline and then placed on the skin with the electrodes over them. These precess of cotton may be discarded after each treatment thus obviating the necessity of sterilizin, the electrodes themselves.

The Patient -If the patient is appearing for the first treatment it is well to explus to him, briefly somethin, of the nature of the treatment and the sensation he will experience. It is quite usual to find that patients at first fear 'electric shock and will not properly relax nule a mentally prepared and made comfortable On the treatment table the part to be treated must be well supported and the patient should be able to relax perfectly Blankets, rubber sheeting or bath towels should be provided to keep the patient warm and his clothing dry Next the skin covering the areas where both the active and indifferent electrodes are to be applied should be carefully examined. All evidence of outments oils limments or other applications when found should be removed by sup and water or alcohol Some of the e sub tances are not to facili tate skin burns and all oily media are poor conductors of electricity If any abrasions are found they should be covered with dry gauze and adhesive plaster The electrodes of proper size and shapo having been selected and thoroughly sorked in a 1 or 2 per cent value solution they are ready to be applied. The pads of absorbent cotton are sorked in the same solution, the excess of moisture gently squeezed out, and placed evenly on the skin. The electrodes are applied over them the appropriate cord tip is crited and the whole bound snugly on with clastic webbing except in such positions as the back of the shoulder where the patient may conveniently lean against the electrode thus holding it in place bath towel may be bound on or held by the patient to keep the electrode in place In any event a perfect contact must be made to prevent burn Frerything is now ready for the treatment The current shoul ] be turned on slouly and the operator should watch the putient as well as the meter When a stinging sensation is felt by the patient it is well to wait a few minutes before raising the current to maximum Whenever this sensation is excessive and the current strength is not too great in proportion to the size of the smaller electrode the current should be turned off slowly and the patient's skin examined for possible abrasions which were overlooked

some manner. The shelt improvement in the circulation which it is possible for us to obtain does not account for the sum total effect of stimulation we are able to precure. For instance, in givenism of the brain there must be, in addition, a distinct increase in the metabolism of the multivalual memors of the central nervous system.

## TREATMENT

Technic — All the switches on the appuratus should be turned of, the wall plue, meeticd and the mechanic examined to see that all connections are tight. The cords should next be at ished to their fermions and should constantly be watched to see that they are in good condition. The frequent sorking of the ends of the cords for polarity testing and treatment is apt to rick even the best material of which their metal conter is made. I break in the wire is not usually taible through the concern, but, if present, will interfere absolutely with the success of the treatment. The polarity should then be tested by either of the methods above given and the cords in taked so that they will not become confused.

and the coris milkin so that they will not become confused.

Electrodes — I lectrodes of the proper size and material should be at band sterilized if possible. In selecting the proper electrodes to be used the following points should be kept in maid.

1 The indifferent electrode should be, roughly, double the size of the intime electrode and it may be placed in any convenient position, usually a short distance centrally and opposite to the latter

2 The size of the ietive electrode depends upon the area which it is desired to treat, and it is placed in the closest possible proximity to that

area

3 The strength of the current desired must also be considered in
determining the size of the active electrode, because it is not safe or
comfortable to use more than 11/2 milliamperes of current per square
used of this active (smaller) electrode

4 The shape of the electrode is also determined by the area to be treated For instance, in a treatment over the sciatic nerve an electrode yery long and narrow should be selected

Most of these electrodes are constructed with a metal screen back, to which the cord trp insert is soldered and to the face of which felt or other soft covering is attached. This metal screen back may rust and break, with the result that an undue concentration of current is applied to the pitent, if the size of the fit his been taken as the gage for determining the proper current strength. Vany of these heavy felt coverings take a considerable time to soak through and properly transmit the current They should never be placed on end to dry, as gravity will produce an

uneven degree of monsture while they still seem wet enough to reapply without sonking. When the smill due electrodes are used with a hooplike metal inm they are apt to become conserve and the patient receive a concentration of current from the rim rather than from the whole electrode. They must be kept flat by cotton or a suitable covering of gauze. Where gauze is used as the covering not less than twelve to fifteen layers should be applied. In the application of electrodes to patients it is advisable to have plenty of absorbent cotton at hand. This may be cut not sizes slightly larger than the electrodes well soaked in saline and then placed on the skin with the electrodes over them. The pieces of cotton may be discarded after each treatment thus obviating the nece sits of sterilizing the electrodes themselve.

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Precautions —1 Patients should receive little, if any, sensation from the treatment A slight tingling is all that is permissible. The meter reading lone cannot be depended upon Occasionally, during the treit mont, the meter reading will increase. This may be due to the fact that corfain ions are being introduced which tend gradually to reduce the resistance of the skin and subentineous tissue to the passage of the current More often the meter needle will gradually return toward zero. This occurs when the skin is becoming dry or when certain ions, such as the metals, are long introduced which form insoluble elements with the

ions already in the tissues

2 As stated before, watch carefully for abrusions and, if found, properly cover them

3 In treatments about the head, especially in galvanism of the brain, it is very necessary to have a current of absolute steadiness. That derived from batteries or through water resistance is more safe than current tiaken from the main. The current must be turned on very slowly, never in large amounts, and the patient watched constantly for agas of distress or vertige. Throning off the current at the end of the treatment must be done with can't care.

4 In treating with the lable, or movable, electrode, it is better not to lift the electrode from the skin but to stroke firmly and rhythmically Removing the electrode from the skin changes the treatment from that of constant to that of interrupted gulwanism with quite different results

5 Be particularly careful not to allow any metal to come in contact with the patient's skin Watch, especially, in this regard patients who are restless or who movo the part under treatment in any way

6 Anesthetic areas, such as those covered by sear tissue and other skin areas just distal to sears, must be treated with extreme care. Leep in mind the unreliability of the meter reading. The important point is that dryness of the electrode causes great skin resistance and the concentrition of caustic elements, while there is a retro-ression of the needle There is also in increase in the unpleasant skin sensations which the pitient experiences. In the anesthetic condition we are considering he does not receive this sensatory warning and therefore we must be doubly entions. It is well to use k a current and shorter the time of the treat ment even to the point of getting less effect per treatment

7 If any adjustments of electrodes or of the patient's body are required, the current must be turned slowly and completely off before

they are made

8 Erythema other than a slight reddening or increased ensitivity of the patient a kin after treatment requires that these conditions sub-ide

before further resumption of treatment

The Galvanic Bath - The _alvanic bath both local and _eneral, in becoming widely used. It has several advantages over the application of the current by means of the ordinary electrides. In the first place every square inch of skin immersed in the water becomes electrode surface hence relatively larger amounts of current may be applied with a mini mum of disagreeable sensation Swoulds perfect contact is of course a sured and we do not have to watch for contact of metal to the skin or spend unnecessary time properly to adjust the ordinary types of electrode

Local Treatments - The e may be given in any container made of non-conducting material such as norcellan or earthenware. Such con tainers are manufactured of suitable size and shape to accommodate a single extremity. On the inside of the continer is placed a plate of carbon or metal which extends down into the water and conducts the current from the cord to the fluid. An ordinary pange electrode may be placed over the edge or on the bottom of the container of this built in place electrode is not provided. The indifferent electrode may be another similar container or of the ordinary felt type and applied over the lower back or bolund the houlder To follow the principles already outlined, it would have to be a fairly large pad to equal or exceed in area the square inches of Ain surface immer ed

Schnee Bath - This is a well constructed eries of four continners for each of the extremitie two three or four of which may be connected up at the same time. The temperature should be 99 to 100 T and kept is nearly as possible constant. There is all never be any change made in the volume of water after the current has been turned on as such change may result in sensitions alarming to the patient. It is necessary carefully to protect the clothin, from becoming wet during the treatment Bifurcated cords may be used so that the positive and negative pole may be each applied to two continuers at onc. As in the other types of treat ment the current is turned slowly on and off, and the same slight tingling

is a good guide to the amount of current to be used

General Galvanio Bath —In general body treatments, there should be sufficient water in the tub to cover the body to the shoulders, and no change made in its volume once the treatment has been started. Occa sionally, the sinusoidal or faradic, with or instead of the galvanic, may be given by the same technic for general tonic effect. Before the patient enters the bath, the temperature of the water should be tested by the attendant introducing his hand or elbow into it. The desired quantity of current may also be tested in this way, after which it is turned completely off and the printer placed in the buth. A depressing or fatiguing effect follows too prolonged or too strong treatment and, on succeeding days, accordingly, it should be modified. The printer should never be left alone during the body buth treatment, as he is very helpless and, should any connection be loose or any change in the current flow occur, he may become frightened and the treatment and disastronally. Frequent inspection should be made of the appearatus and of its connections.

General Galvanization—In certain cases where the galvanio bath is impractivel for any reason, a general treatment may be given by means of an especially constructed chair, which is usually of the reclining type, constructed with metal electrodes on the back, seat and arms. These plates are provided with fixtures to hold the tips of the cord from the plates are provided with fixtures to hold the tips of the cord from the body may be treated at one time, though it is generally used for entire body treatments. The electrodes may be prepared as already described. When these treatments are given for sedative or mild tome effect, the current should never be strong enough to produce more than slight tingling. To produce the greatest results in therapeutics, the galvanic current must be administered with circfully selected and in dividual technic. It cannot be employed with best results in large clauser cocurring hastly administered treatments to large numbers of cases.

# IONIZATION

Definition —Ionization, ionic medication or cataphoresis is the introduction from without, or the internal rearrangement or concentration within, the tissues of the ions of various chemical elements, by means of the selective polar action of the constant galvanic current History —Several physicists had suggested the possibility of utilizing

History—Several physicists had suggested the possibility of utilizing this property of the galvine current during the last years of the nine-teenth century. Leduc, of Nantes, in 1900, was the first to utilize ionization in the treatment of diserse. Since that time there has been a rapid increase in its employment in the trapenties. W. J. Turrell, of England has done very valuable work in clarifying and systematizing the physical

and chemical principles related to this subject, and G Betton Masses, of Philadelphia has made many valuable contributions to the literature

Chemistry—Certain acids bases and salts in solution are broken up to the prisinge of an electrical current through them, into atoms which take on different electrical charges. These are termed ions. The e ions or wanderers are more or less untable and enter easily into now chemical combinations. The term ion was fir t given to the electrified atom by Faraday. Ledne illustrates the action of the constant current in dissociating chemical bodies and their sub-equent polar migration by comparing, the process to a dance. The puritial association of the positive and negative ions is represented by the partners on the biliroom floor. The action of the passage of the current in separating and putting them in motion according to their electrical affinity is computed by him to the constitution of the music and the assembling of the fidics at one end of the room and the men at the other.

Cations are ions containing a positive charge introduced at the potential tries pole or originating in the pathwar of the current, and traveling toward the negative pole. They include metals and hydrogen

Amons are those ions bearing a negative charge which move toward the positive pole and include chlorin common bases and the hydroxil group

Turrell emphasizes a point overlooked by many other writers on this subject, namely that the chemical action at and immediately below electrodes is electrodivitie in nature and is not the same as that which occurs in the interpolar pathway. The dissociated molecules in the ionic with the not exhibit there former chemical affinity which is temporarily replaced by the electrical charge. When they reach the immediate vicinity of the pole than electrical charge and again become chemically active as before. The velocity of movement which the various ions exhibit differs which be discovered being by far the most rapid. Many of the effects we produce are due to the extremely rapid migration of the hydrogen and hydroxyl ions. The less the atomic weight the faster will the ross fraid.

McGill quotes three experiments illustrating the importance of the epolar effects

1 Fill a glass tube with absorbent cotton sorked in sulme. At one ead in crt a mall pling of cotton moistened with potassium iodul. In the other end place a similar pling wet with starch solution. Attach the eathole to the potassium iodid end and the anode to the starch end and turn on the current. The potassium iodid will be dissociated into its elements potassium and iodin and the iodin will be directated into its sole where the starch will turn blue. Reverse the polarity and no such effect occurs.

- 2 Paint two areas on a limb with fineture of rodin. Place a moist ened electrode over each area and turn on the entreat. The brown stam will disappear under the cathode but not under the anode.
- 3 Solk two electrodes in a solution of eccuin hydrochlorid, apply to the skin and turn on the current. The skin over the anode will become anoshetic, that under the cuthode will be unaffected, showing that it is not simple absorption of the drug but selective polar action which has occurred

The belief that drugs are carried into higher tissue is further proven by the appearance in the urme unl silver and by the deaths of animals with the use of the alkaloids

W. J. Lurrell in performing the starch and rodin experiment with a shahtly different technic call attention to the fact that rodin ions are passed through a considerable quantity of strich, staining only that directly under the positive pole Chatsky's experiment tends to prove Turrell's contention A more complicated experiment, where strychnin sulphate was presed through the bodies of two rabbits, placed in circuit, further demonstrates this fact. The strychnin ion was not chemically ictive while passing through the fit rabbit, but only when reaching the opposite pole in the body of the second rabbit did it lo e its charge, become chemically active and cause the death of the animal. An attempt to pass the saley I son through a leg about to be amountated also failed to demonstrate the presence of the drug in the deeper tissues American workers meluding Massey, still believe that there is some ionic effect in the deeper tissues and they have obtained clinical results which it is hard to explain on any other basis. As many of the tissues we desire to affect are comparatively superficial and the condition of theso tissues has been repeatedly improved by ionization, we may assume that we have a procedure of real clinical value

Thrical protests against the term ionization being employed to designate any given treatment, in the sense in which this term has commonly been used, straing that consistion is the dissociation of molecules in solution without the application of any external force. Although the point is well taken, the common use of this term to designate a method of treatment is followed ruber than to introduce a confusion of terms.

Technic -- The number of drug ions driven into the tissues will be

- 1 The current density
- 2 The duration of the treatment
- 3 And inversely as the atomic weight of the ion used

The time factor is of the utmost importance. It requires from 30 to 60 minutes of the application of a current of moderate strength to com

plete a good ionization treatment. Moreover, it has been demonstrated that the best results are obtained by the u e of weak, olutions of drings the e of 1 or 2 per cent being preferred.

Advantages of Ionzation—I The desired element of the drug is driven directly into the affected tissues united of being scattered through the system in the circulation where but a small proportion of it can exert its action on the affected area

2 The least desirable effect—such as those of the alies's group upon the gastro-intestinal tract are worded.

3 Drugs such as cocum may be applied without introducing the needle into the skin

Disadvantages of Ionization —1 The greatest impoint of ionizing effect takes place in the skin and subcut inconstance

2 The drugs which have us yet been successfully used are few in number

Treatments —Under the cathode or negatite pole we apply chlorin in the form of solution chlorid boths from sodium or potassimi both and salicyl from sodium salivelact Lider the anode or positive pole we use time from zine sulphite magnesium from magnesium sulphite lithium from lithium chlorid saliver from saliver nitrate copper from copper sulphate and morphin cocain and quintu

The directions and entitions given in the evre and u e of apparatus as outlined in the chapter on ( alvaism are to be carefully carried out The electrodes are selected and placed as for use in strught gill line current.

Typical Treatment -Let us use, for an example the constation of the scratic nerve for neuritis

A ling narrow active electrode which will extend from the status moteh to the opplical space is selected. A long broad electrode applied to the front of the hip and thigh will serve as the indifferent electrode. The state of the hip and thigh will serve as the indifferent electrode. The state of the solid warms site solition. I sufficient quantity of 2 per cent solition is warmed to about 100° F. A later of ab orbit cotton large enough to extend beyond the retive electrode in reach direction, is immersed in the warm all solition and the excess of saline graph space lost. The solition above this solition and applied directly over the course of the cation true. The active electrode is their placed over this and counseled to the negative pole of the maxime. I she electrodes are smally bound on and the current slowly applied. We ordinarily in 6 to 10 millioners for about forty inmutes. The current is then slowly turned off the electrodes are removed and the him is dred and powdered.

Surgical Ionization — By this term is meant the u a of the polarity effect of the alvalit current to come intrine at a small localized point certain ions which actually de two time. This determines the free transitions which actually de two times.

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  - 3 And inversely as the atomic weight of the ion used

The time factor is of the utmost importance — It requires from 30 to 60 minutes of the application of a current of moderate strength to com-

### INTERRUPTED AND WAVE GALVANIC CURRENTS 295

object of these devices is to secure a sharp clear-cut make and break in the flow of the current through tissues with the general object of inducing muscle contraction

Physiological Effects—It was stated in our consideration of the galance current that it was the abrupt movement or cessation of movement, of ions through the muscle and its motor nerve endings that induced contraction. As ordinarily used the sharp interruption produces ruber a muscle twitch thun normal contraction. In normal nursele with its nerve supply intact the contractile responses are most sharp at that point, usually situated near the center of the belly of the muscle termed the motor point. The phenomenon of the reaction of degeneration will be dreut of under the heading of Muscle Nerve Testing. It may be briefly stated here that interrupted gillamen will be dreut of under the heading of Muscle Nerve Testing. It may be briefly stated here that interrupted gillamen will produce contraction in muscle issue even when its motor nerve is completely severed and a considerable amount of degeneration has taken plue in the muscle itself. Such responses are no longer sharply localized at the motor point, but are

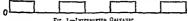


FIG I -I TERBUPTED GALVANIC

diffused throughout the muscle sluggish and watelile in character and with the normal polarity respon es reversed. The application of a sufficient amount of interrupted galvanium to induce an approximately normal contraction would be sharp and unpleasant for the pitient therefore for treatment purposes this type of current has been supersolded by the wave or sinusoidal currents next to be described. We obtain the muscular twitch whenever the current is abruptly started or stopped with use of either the negative or positive pole. When the current is started made, or the circuit closed the contraction is greater than when it is opened, or broken. As we would expect the negative pole or cathodo gives a more mirked response therefore it is commonly stated that the cathodal closing contraction is greater than anoth I dosing contraction or KCC>ACC in normal muscle. It must be remembered that occi sonally the Tibialis anticus and Supinator longus are exceptions to this

#### WAVE GALVANIC CURRENTS

Sources and Apparatus —There are several types of apparatus on the market which so modify interruptions of the galvanic current that they become regular and warukles instead of abrupt. The term simewold has at times been incorrectly applied to this type of current. A true warucurrent is one which rives from zero to maximum and returns to or

prevented in our ordinary medical ionization by the size and moisture of the electrodes

The active electrodes used in surgical ionization are of metal only, and usually in the form of needles. The indifferent electrode used is the ordinary galvanic pad, which is placed a short distance from the part to be treated.

For strong bactericidal effect npon infected sinuses, carbincles and boils, blunt needles or rods of zinc are sometimes used as the positive pole. When so used, a pearly white color appears on the surface of the infected tissue and the bacteria count is greatly reduced.

Steel needles should never be used, as they leave a black stain on the skin which is practically indelible. Platinum is the best needle material Beside single needles several may be used, inserted into one fixture.

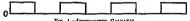
Technic -The machine and different electrodes are prepared as for The needle or needles are then unserted into the mass to be treated. When the current is turned on, a shight blanching of the skin is As a rule, only a very slight amount of current is necessary to secure this effect. As soon as the blanching occurs, the needle should be withdrawn and inserted into a different part of the growth. The positive pole has a tendency to harden the tissues and the needle is difficult to remove. The time of the treatment in this case should be brief. This effect is not seen with the use of the negative pole, which softens tissue andly and in a few seconds the needle can be easily withdrawn tymical examinle is the removal of superfluous bair. The light should be so placed as to shine directly on the hair follicles A platinum needle is selected and connected to the negative pole. It is then inserted gently, following carefully the direction of the hair root as far in as it will pass easily perhaps to the depth of one-eighth inch. The current is then turned on and increased to 2 or 3 milliamperes, while the needle is held steadily in place. In a short time, a number of small bubbles will appear at the root of the hair, then the current is turned off The hair should then be withdrawn with forceps, without the use of any force Not more than ten to twelve hurs, or one small growth, should be removed at one sitting in order to avoid unnecessary irritation to the skin and the pos sibility of subsequent scarring A strong current should not be used as it is not any more efficient and may destroy more tissue than is intended

# INTERRUPTED AND WAVE GALVANIC CURRENTS

# INTERRUPTED GALVANIC CURRENT

Sources —Various devices have been perfected to interrupt the gal vanic current. This may be done by means of a metronome, with the use of an interrupted handle electrode or by a key on the apparatus. The object of these devices is to secure a sharp clear-cut make and break in the flow of the current through tissues with the general object of inducing muscle contraction

Physiological Effects—It was stated in our consideration of the galvanic current that it was the abrupt movement, or cessation of movement, of nost through the muscle and its motor nerve endings that induced contraction. As ordinarily used, the sharp interruption produces rither a muscle twitch than normal contraction. In normal muscle with its nerve supply intact the contractile responses are most sharp at that point, usually situated near the center of the belly of the muscle termed the motor point. The phenomenon of the reaction of degeneration will be discussed under the heading of Muscle Nerve Testin. It may be briefly stated here that interrupted gala anism will produce contraction in muscle used even when its motor nerve is completely severed and a considerable amount of degeneration has taken place in the muscle itself. Such



TIG I -- INTERRUPTED GALVANIC

diffused throughout the muscle sluggish and wavelike in character and with the normal polarity responses reversed. The application of a sufficient amount of interrupted galvanism to induce an approximately normal contraction would be sharp and unpleasant for the patient. therefore, for treatment purposes this type, of current has been superseded by the wave or sinusoidal currents next to be described. We obtain the muscular twitch whenever the current is abruptly stirted or stopped with use of either the negative or positive pole. When the current is started made, or the circuit closed the contraction is greater than when it is opined or broken. As we would expect the negative pole or enthodogives a more marked response therefore it is commonly stated that the cathodal closing contraction or ACCS-ACC in pormal nusele. It must be remembered that occasionally the Tibiahs anticus and Supinator longus are exceptions to this rule.

#### WAVE GALVANIC CURRENTS

Sources and Apparatus —There are several types of apparatus on the market which so modify interruptions of the galvanic current that they become regular and wavelike instead of about. The term sinusoidal has at times been incorrectly applied to thus type of current. A true wave current is one which rises from zero to maximum and returns to or

nearly to zero and repeats in regular rhythm. The polyrity once fixed does not change therefore we are dealing with a series of negative or a series of positive ways. These wires of current may be varied in both voltage and amperage to a fine degree by recent improvements in apparatus. These variations are attuned in the last type of medianes by means of cause on revolving dram, which make contacts of variation, frequency, duration and intensity, between which there is a period of compartively no current flow.



Physiological Effects —The result of application of this type of gal vanism to patients is steply a combination of the cof stringht and interrupted given in The polarity effects of straight galaxies are jurseent but being intermittent and not continuous are not as great in their total effects is with continuous current. On the other hand, the intermittent movement of sons through the motor neric endines produces a rightnine of changing and fairly sustained stimulation which leads to good mutually contraction. It is a better current for the innest purposes than interrupted galaxies in his not as good for musch testing. The curr and apphention of electrodes follow the same general principles aired out hined. This current has proved of great value in the sumulation of atomic, but otherwise normal, nursele tissue such as relaxed abdominal wall, and may be substituted within its limitations for sumsodial or interrupted galaxies.

# SINUSOIDAL CURRENTS

Definition — A true sunsoidal current is one which alternates in perfectly regular opposite and equal evels or phase. The current strength rises from zero to maximum on the positive side and returns to zero,

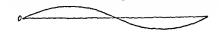


FIG 3 -- SION SITE OIDS

followed by a similar ri o and fall on the negative side, which may be plotted as a true sine curve

Physics—An alternating current is conducted around the primary uniting. This alternation primary current produces regular and even alternation in a secondary uniting from which the patient is treated

The secondary winding reduces the voltage sufficiently for treatment pur po es and might therefore, be called a 'step down' transformer. With the  $\Delta C$  current also a somewhat similar arrangement is necessary to decrea e both the voltage and the frequency of the current alternations It is evident that a current alternating rapidly enough for highing pur



po es would be far too rapid to employ for the purpose of obtaining musculur contractions

Physiological Effects —The sinusoidal current is one of the latest developments in electrotherapeutics and one of the most valuable for the following reasons

1 The gradual rise and fall in current strength and the evenness of the wave so produced is easily borne by the patient as compared to the faradic and interrupted galvanie currents



FIG 5 -- INTERBUPTED STAUSOIDAL

2 It has been proved that there is increased reaction when the negative pole is u cd where the positive has just been or vice ver a This central is obtained in each cycle of the sinc current, and gives it a distinct advantage over any form of simple wave galvanic current.



3 In a given time there is much less danger of overstimulation

with this current than with the sharp and ahrupt current of interrupted galvanism

4 A real stimulation of the metabolism of muscle ti sue follows

4 A real stimulation of the metabolism of muscle ti sue follows the application of this current, even when a perceptible contraction is not produced

There is no break in the current that is, no distinct rest period and, because of its smoothness, a much larger amperige may be used than

nearly to zero and repeats in regular rhythm. The polarity once fixed does not change, therefore we are dealing with a series of negative or a series of positive waves. These waves of current may be varied in both voltage and amperage to a fine degree by recent improvements in apparitus These variations are attained in the best type of machines by means of cams on a revolving drum, which make contacts of varying frequency, duration and intensity, between which there is a period of com naratively no current flow



Fig. 9 - Store Supered Garage

Physiological Effects -The result of application of this type of gal vanism to patients is simply a combination of those of strught and interrupted galv mism. The polarity effects of straight galvini m are pres ent but, being intermittent and not continuous are not as great in their total effects is with continuous current. On the other hand, the inter mittent movement of ions through the motor nerve endings produces a rhythmical changing and fairly sustained stimulation which leads to good mu cular contraction. It is a better current for treatment purposes than interrupted galvanism but not as good for ran cle testing. The care and application of electrodes follow the same general principles already out lined This current has proved of great value in the stimulation of atomic, but otherwise normal, muscle tissue, such as related abdominal wall, and may be substituted within its limitations for sinusoidal or interrupted galvanism

# SINUSOIDAL CURRENTS

Definition - A true sum ordal current is one which alternates in per feetly regular opposite and equal cycles or phases. The current strength rises from zero to maximum on the positive side and returns to zero,



Fig 3 -Slow Sixusotpan

followed by a similar rise and fall on the negative side, which may be plotted as a true sine curve Physics -An alternating current is conducted around the primary

This alternating primary current produces regular and even alte nation in a secondary winding from which the patient is treated

tions in the healthy muscles, and by degrees, the frequency of the wave may be increased, until three contractions per second are given. During the entire course of this treatment the muscle may gain from invisible response to a slight flicker of the tendon and, finally to a full deep contraction. After good contractions have first been chetted occisional tests should be made with the faradic current and when the response with the faradic is good, the case may be treated thereafter entirely by faradic rather than by sinusoidal current. From this regime pass on to active motion and occupational therapy.

The sum oddl current is very useful as an aid in removing circulators than through the mechanical effect of muscular contraction, following other physiotherapentic measures, such as an application of heat which will aid in preventing the organization of the evudate in a bruised muscle. As a local substitute for voluntary exercise it has many advantages. It is being increasingly employed in the stimulation of the finer intrinse muscles in some of the organs of special sense. The gatto-intestinal tract may be both directly and indirectly stimulated by its use. One of the very last of the electrical currents to be perfected it offers possibilities in the field of therapeutics that have as yet been but partly explored and it is expected that the indications for its use will very rapidly widen in the near future.

## FARADISM

Definition -The faradic current is an induced alternating current derived from a so-called induction coil

Ristory—This is one of the oldest of the fundamental types of electrical current. The principles of magnets and their relation to electricity were first observed by Faraday in 1831. His subsequent work formed the hasis for the introduction of the dynamo, the telephone and much of our modern inchine.

Physics—This current is chrameterized by relatively high yoltage and amperage and is alternating in character. A weak galvanic current desired from a direct current main or from batteries passes through a coil of wire surrounding an iron core which becomes magnetized

The induction coil is a very old and very well-known piece of electromedical appearatis and although the coils produced by different makers are of somewhat different construction the general principle is the same and the current differs very little in character or quality. We have a core made up of a boundle of fine wure which is surrounded by a number of turns of a somewhat coarser wire. This is known as the primary coil. Opposite one end of this coil is a small piece of metal fastened to a rather delicate metal spring. A small serew is mounted

with the interrupted galvanic. This sine wave then is able to stimulate the muscle, even in a degree too small to produce a marked contraction and without the polarity effects of the galvanic current. It may be used for the purpose and to the point of obtaining a good contraction in a partially paralyzed muscle, but very few contractions are all that are permissible.

Technic —The care of the machine, especially the lubrication of the rotter control, is very important, if one desires to obtain a smooth, fine current. The part to he treated and the electrodes are prepared in the same way as for galvaniam, the large indifferent electrode usually being placed opposite, and somewhat centrally, to the smaller testing or treating electrode. The mechanism of the machines, from their nature, must be intricate and delicate and they require more care perhaps than any machines which we use except the static.

Major O M Sampson, who had charge of perhaps the largest periph eral nerve clinic in Army Hospitals, has perfected a technic which cascareely be improved upon and which deserves a detailed description. The paralytic muscles are tested daily before the treatment and before receiving distillering or whirlpool bath. The opposite limb, if normal, is tested for a control.

Place the patient, and especially the limb to be tested, in a comfortable position. During the test, the limb is placed on glass or wood covered by a towel or blanket. Test each motor point separately sad compare it with the corresponding motor point on the normal limb. If both limbs are affected, another person may be used as the control at first. After sufficient experience this will not be necessary. After determining the motor point and marking it with a dermal pencil, use a small test electrode on the motor point, with both sinusoidal and interrupted galvanic currents. Gently increase the rheostat, from zero up to the point where it gives a good contraction in the normal muscle. To treat the affected muscles, take a slightly larger electrode and apply it to the motor point on the affected side. Start with the rheostat at zero and advance it to not over two-furing of the strength that was necessary to secure a response in the healthy muscle. Use a slow wave, only one or two to the second. Keep a careful daily record as to the number of waves given to the part being treated. Not over three waves should be given the first day. Increase one daily until ten are being given at one treatment, after which dup to three and repert another week. If, then, a test does not show improvement, keep repeating this schedule. When a marked improvement is shown, continue to increase one ware daily until twenty are reached, after which a series dropping hack to ten and working up to twenty is instituted until the muscle possesses marked signs of regeneration. At this point the rheostat may be advanced to the full amount which was necessary to produce vigorous contrac-

especially desired. Then a small brush, consisting of a bunch of fine tinsel wire is provided to serve as the netwic electrode. This is attached to one terminal of the machine and the brush moved back and forth lightly over the surface of the skin. There is of course, not the danger of burning with this current that there is with constant current, on account of the frequency of alternations per second. However, extreme moisture of the electrodes is nece by the reduce the resistance of the dry kin and reduce the numbershift hingling.

The alternations so produced are not even or rhythmical in their periodicity. There are of course no polarity effects in the u of this current. There have been instruments de i_ned to measure the faradic current, but they are not as satisfactory as in the case of galvanic and high frequency current so that the sensation of the patient becomes the best guide that we have. In the usual type of apparatus, this current can be modified in its strength by a set relationship between the second any coil and the cope. A rough measuring scales is marked on the mechanic

Major Bristow, of England further modified a small portrible appressure in providing for the manual insertion and withdrawal of the ere into the machine thus producing a fraudic wave current, visualine, continual tetanization of much and perfecting an apparatus of great

Another modification for generalized mulcular contraction aimed

Another modification for generalized mutualize contraction aimed expectable at the reduction of adaptors usual is that of Bergomic of France in which the current is applied to large muscle group by means of electroles on a specially constructed chair with diversified control switches on the chair reself

Since the furadic current acts on the mu ele through the nerve the shripe t effect is produced by its application on the motor point of a giren mu ele This point as unde corresponds to the point of entrine of the motor nerve in the belly of the muscle. Therefore at follows that the active electrode hould be a small one, varying in diameter from eachalf to one and one half in index

Naturally for the proper testing of the interce of and similar small am elea, the sharpest possible bealization is desired, while for such mu clea as the bicaps a somewhat larger pad may be u ed. An indifferent electrode should be four by six mehes or even larger and both electrode should be four by six mehes or even larger and both elements of the discount of destruction burns with fractisms which mu the construit watched, for instance, in the use of the gilvaine current. The faradic current also may be interrupted by a metronome by an interruptic handle on the active electrode or letter still mids watchle by the core device described in the Briston apparatus. The mosther and more even the entreat, the better the risult. In any cit, the current bould be delivered.

so that its point is nearly in contact with this spring, at about the middle of its length. One end of the primary coil is connected with one pole of the current supply and the other pole is attached to the seren. The coil and the spring are also connected. The current flows from the main or bitteries to the coil, from this to the spring jumping acrosto the screw, and so completing the circuit. The current passes through the coil with its wire core milling, it temporarily a magnet which draws the small block of metal on the end of the spring toward it. In doing this it draws the spring away from the screw, breaking the circuit and stopping the flow of the current. When the current flow ceases, the coil loses its mignetism and the piece of metal flows back and the screw resumes its first position in relation to the spring.

Physiological Effects -The furadic current is the nearest approach to the normal motor nerve impulse that we are able, artificially to obtain The usual alternation rate of fifty per second probably closely approxi mates the motor nerve stimulation rate. It nots through the nerves them selves the stimulation being carried into the muscle at the motor point and distributed to the individual fibers by the same mechanism that is con cerned with their reception of the normal motor nerve impulse. For this reason, it is easily seen that, where the conductivity of the nerve is interfered with there will be a corresponding interference with the transmission of faradic stimulation. This, it will be remembered, 18 contrary to the action of the interrupted galvanic current, which is able to secure a somewhat modified reaction of muscles by acting directly on them without continuity of nerve structure. The type of faradic coil which gives the most rapid alternations secures the best motor response Slower alternating currents produce an undue amount of sensory dis turbance in proportion to the motor responses secured by them. Formerly, the faradic current was widely used for it undoubted effect in increasin. metabolism in completely paralyzed muscle groups where motor responses could not be cherted by its use Sinusoidal, or some form of wave galvanism is to be preferred for this purpose and the use of the faradic current reserved until the time when, as described in the section on sinusoidal currents a fairly good contraction is obtained by its use Where cutaneous stimulation is desired, a faradic brush is of value, but surface high frequency is more often used

A systemic result may be obtained where the neuronusculur system is normal but the prinent with a lurge amount of adipose it sue is handreapped. This may be burned up by the method of general muscular contractions induced by the faradic current, after the technic of Bergonic, described later in this chapter.

Technic of Faradic Treatment — The faradic current is administered, in general, in the same munior as the gulvanic current. Most electrodes are used, except in eases where a cutaneous stimulation is

shout ten minutes. These treatments are given in courses of six to ten weeks. Application should be daily for the first three weeks then on alternate days starting at twenty minutes and uncreasing to sixty. An average reduction of one-half to one pound per day may be expected and it has been the rule for improvement to continue after the treatment has been also extracted.

These treatments consist in the ma cles being contracted in a rhyth mical manner, in which the entire musculatuse of the body is concerned

In this way, a combustion within the muscles is greatly accelerated, but the signs of bodily fatigue which follow violent everses are almost wholly lacking. Moreover, there are pitients who, because of excessive weight are cardine condition, could not take everees which would in a marked degree aid in consuming their deposits of fat and their elimination of body wastes. For them this technic as ideal

The type of current is described as a coarse wire faradic. The interruptions of the current are made about thirty per second or clo e to the normal rate of muscle fibrillation and the miscular contractions are made to correspond as closely as possible to the beart rate. There is, in addition a general building up of the musculature replacing fat

With increased respirations and greater activity of the kidneys, active measures to remove, as fast as possible, the cause of the obesity and to regulate the patients a routine are of course essential. In many cases where too tigid dieting cau es marked weakness and



FIG 7—THE POLYBINE GEN ERATOR COMBINING MANY TYPES OF CONTRACTILE CLEENTS

where active exercise is impossible this treatment should prove of value Within a reasonable time after treatment is instituted many patients according to Titus, are withing and able to begin various types of active exercise.

#### COMBINED CURRENTS

Several types of apparatus have been perfected whereby a measurable proportion of galvanism and farada m may be combused in a single treatment. It is crudent that such a current will be of advantage where a muscle is just beginning to respond feebly to faradaim. Practically, however, the since or the interrupted galvanic may be used, until a sufficient response permits of our treating by the faradac current alone.

to the muscle only in such quantity as will procure a good contriction and for the least possible space of time in which this desired result may be obtained

Normal physiological exercise of a muscle requires a contraction, dur ing which the venous blood and lymph are squeezed out of the muscles and relation transfer and state of the arterial side capillary intake is made possible. When the application of an smount of current, sufficient to produce a good contraction, is maintained beyond that point of contraction, the muscle becomes tetanized and these natural changes in the circulation are interfered with Skill in finding the exact motor point decreases the amount of current needed to obtain a good contraction Therefore, the unpleasant effect of too strong a current upon the patient's sensory nerve endings is lessened. It should never be necessary to use such an amount of current as will "splash through" to neighboring niuscles, the stimulation of which may be unnecessary or teen detrimental A further point which should be emphasized is that the rest periods between contractions should be much lenger, by four, or even eight, to one, than the period of the contractions. The British olcetrother musts empley two-fifths contraction and three-fifths relaxation There is always the danger of giving too many stimulations to a weakened and regenerating muscle Of course, the faradic current is not used until a muscle has regained a certain amount of power From two to ten contractions, usually starting with the former and work me up toward the greater number, is sufficient, as a rule. Overstimula tion is of real danger to the muscle

Example —Stimulation of tibialis antiens Make the patient comfortable with a small support under the knee With electrodes properly prepared, place the indifferent electrode, of four by six inches, inder the ealf of the leg, the leg resting upon it I coate the motor point snd, if necessary, mark it Then, with the active electrode remaining in contact with the muscle at this point and with just sufficient current to produce a fair contraction, give from two to ten contractions according to the conditions of the muscle at the time.

Treatment of Obesity—Edward C Titus of New York has used a modification of Professor Bergome's technic for a number of years in the treatment of this condition. He uses a semireclining chair with large metal plate electrodes for the buck and adjustable extension for the legs. These electrodes are attached to the corresponding rhoestat of the machine and there are two electrodes for the abdomen two for tho legs and two for the anterior surface of the thighs. These electrodes are all covered with a moistened covering of the same thickness. They are bound on, those on the abdomen being held with sandbags. Good contact of the patient and chair electrodes is essential

Contractions are given very feebly at first, coming up to maximum in

Physics -The current used in diatherms is the bipolar d'Arsonval current, which has a high voltage and relatively high amperage. The frequency of o cillation mu t be great enough not to tetranze the muscles. that is over 10 000 alternations per second. To produce the desired type of current some device must be used to 'step-up both the voltage and the frequency of the current coming from the main Major C W. Samuson has clearly illustrated the effect of high frequency current, by comparing it to water power somewhat as follows A stream of water six unches in diameter, having a pressure of a thousand pounds per square inch would be difficult to control and dangerous to life if it struck the body but if passed through a great nebulizing apparatus which reduced it to a fine mist, it would float and rise in the air whatever the pressure lathed it Such a spray would correspond to our high frequency current and could be applied to a pain it with it ill effects

The studyed d Arsony il type of high frequency machine is further described as follows. It contains first a control mechanism either a rheo tit choke coil or antetransformer to govern the amount of current drawn from the main Secondly a 'step-up transformer, usually oil immersed which takes the low voltage current and steps it up to the the amp rige decreasing in direct preportion. This first transformer does not affect the frequency of the carrent, but only the voltage and amperage which is till dangerously high lap-offs or kads are taken from the accordary on this transformer and councied to the primary of a second step-up transformer which may be of the Tesla type usually wax im

mersed, or a d Arsonyal solenoul

I ctucen the first and second transformers are placed two devices a conden er and a spark gap. The function of the condenser is to tore the current and to step-up the frequency. The condenser usually employed in the diathermy apparatus courses of a number of met il plates eparated from each other by some insulating material such as mich or glass and his a larger cipacity than I ex len jars used in other types. This greater capacity produces o cillations which are more usuand. The condenser is placed in the secondary errout. The current may then pass into the condenser or around the metallic secondary current in which the resistance 18 1010

In order to make the current enter the conden or the spark gap which is another rest time of variable amount is placed in the circuit. Now the current meeting this new resistance tends to travel the reverse side of the circuit into the conden er and the conden er is charged with it, the first plate being charged po itively and the econ linegatively by induction and so on When charged to capacity the current is discharged en masse ners the spark gip completing the high frequency circuit

The circuit leading from the fir t to the secon I transformer must be

# HIGH FREQUENCY CURRENTS

# DIATHERM

Definition—Disthermy distherms transfermy or thermopeners tion is the bipolar application of the d Arsons if type of high frequency current which develops a form of heat, sometimes called conversive, day within the transfer

History -- In 1890 D Arsonval demonstrated that the main effect of the high trequency currents in the body was the production of best



Fig. 8 — I ortable High frequency Apparatus Delivering 2,000 Milliamperes of Cor nent

The following year he used cur rents up to 3,000 milliamperes That same year, Nacola Tesla proved that large currents of high potentiality, engrents that could light up several memdes cent lamns, mucht be used from Leyden pars without harm to the body In 1896, D Irson d showed that he could produce heat effects in patients with our icute as low as 500 milliamperis and in 1898, began to treat diseases with these currents. The first use of the d treamal cur rent in therapenties u is made in this country by Frederick De-Araft in 1906 in the office of

William Benham Snow, of New York In 1907, Nagel chindle designed the first real diathermy apparatus and gave the name diathermy to this form of treatment. Tesla had suggested the use of high frequency currents in medicine as far back as 1991. We are indebted to Border, Leconite, Bounnot, Wertheum Ammera and others, for early experimentation with this current. In 1908, you Verndt, you Preuss and you Ayneck urged the use of the division of current in the first that it of joint divisit is Diathermy was first used in England in St. Bartholomew s Hospital, in 1909. In 1910. Nagelschinntle used diathermy in hospital practice, but with a type of apparatus that did not give the properly sustained oscillations. From 1910 on a number of new types of apparatus were deteloped, both in this country and abroad, until we zow have several makes of his, Irequency mediance combining not only a d Arsonval current of good quality, but Tesla and Ondin currents as well.

Physics—The current used in diathermy is the bipolar d Arsonval current, which has a high voltage and relitarely high amperage. The frequency of socillation must be great enough not to tet must the muscles that is over 10,000 alternations per second. To produce the desired type of current some, device must be used to step-up both the voltage and the frequency of the current coming from the main. Major C. M. Sampson his clearly illnerited the effect of high frequency current, by comparing it to water power somewhat as follows. A stream of water six inches in diameter, having a pressure of a thousand pounds per square such would be difficult to control and diagrams to hife if it struck the body but if passed through a great nebulating appraising which reduced it to a fine mist, it would float and rice in the air, whatever the pressure behind it. Such a spray would correspond to our high frequency current and could be applied to a patient with no ill effects.

The standard d Arsonval type of high frequency machine is further described as follows: It contains first, a control mechanism, either a face tit choke coil or autotransformer to govern the amount of current drawn from the main. Secondly a "step-up transformer usually oil mimered which takes the low voltage current and steps it up to the disredvolty, somewhere between ten theo and and thirty thousand volts, the amperize decreasing in direct proportion. This first transformer does not affect the frequency of the current but only the voltage and amperize which is still dangerously ligh. Tapoffs or leads are tiken from the secondary on this transformer and counceted to the primary of a second step-up transformer, which may be of the Tesla type usually wax in

mersed, or a d Arsonval solenoul

Between the first and second transformers are placed two devices a condense rand a spark gap. The function of the condenser is to store the current and to step-up the frequency. The condenser usually employed in the distinction appearants consists of a number of metal plates separate from each other by some insulting material such as mice or glass and has a larger capacity than Leyden jars used in other types. This greater capacity produces o cillations which are more set turned. The condenser is placed in the secondary circuit. The current may then pass into the condenser or around the metallic secondary circuit in which the resistance is low.

In order to make the current enter the conden or the spirit, gap which is another real tance of variable amount as placed in the circuit. Now the current meeting this new resistance tends to trivil the rever, aside of the circuit into the condenser and the condenser can cause the current for the tendenser and the condense real charged with it the first plate being charged positively and the second negatively be induction and so in. When charged to capacity the current is discharged on masse area who park gap completing the high frequency circuit.

The circuit kading from the first to the second transformer must be

tuned to resonance which is done by equalizing the inductance resistance to the capacity of the condenser. Here, the function of the condenser is to store up sufficient power to excite resonance in the circuit

When the spark gap is closed or offers insufficient resistance to the current, the condensers are not charged and there is not enough energy to set up vibration in the resonators. Care of the spark gap therefore is absolutely essential to the proper norking of the machine

The Spark Gap and its Proper Care — The care of the spark gap is perhaps the most important thing the physician has to know in the



TYPE OF HIGH THE

care of his machine. A dirty and corroded spark gap will interfere with the smoothness and evenness of the current to such an extent as to nullify the good that might be accomplished by the treatment. Where the Dehvafit spark gap is used the micas must often be cleaned, rearranged and turned so as to present clean fresh edges. Alcohol is the best substance to clean both the metal and the mica. Where the hooded target spark gap is used, thus too must be cleaned and the ord of the red constantly fresheed and kept level to insure an even current. The use of cork or ground glass for better insulation, and of finer degrees of adjustment in some of the latest types of spark gap, will greatly reduce the amount of error required.

In some smaller types of machine, loose contact may occur between the metal regulator and the but

tons on the rheostat when they become slightly loose by wear This may be presented by inserting a chip of Crook's metal Some types of machine require grounding and, in this case, one must be sure the ground wire is in place

nn place

The Miliamperemeter and Its Significance —In the ordinary type of machine there is placed in circuit a hot wire militamperemeter. This meter only gives a roughly approximate idea of the amount of thermal effect the patient is getting. As Mr. N. E. Dorsey, has pointed out, it measures only the total amount of the current delivered to the patient and takes no account of varying resistance within or without the body. For instance if the part treated has a low resistance a strong current will be indicated by the meter without a large rise in internal temperature. But, if the resistance of the part is high, for example, through the lance a smaller current will produce a more intense degree of heat. Hence the meter records the total amount of current passing while the degree of heat produced depends upon the current density and the resistance of the tissue. With size of electrodes and density of tissue the same, the heat produced varies as the square of the current strength. Thus a

relatively small increase in current strength will greatly raise the internal temperature The reading then will vary according to the type of machine the part treated and other variations in technic in each case, and is only

fairly constant for the same machine used in the same way

Physiological Effects - Diathermy is applied to the body by the bipolar method and heat is generated in the tissues in proportion to the square of the amperage used and the resistance to the passage of the current It must be clear that this is an entirely different form of heat from any heretofore used in medicine and in its effect totally different from that resulting from the application of any form of heat conducted to the skin through the air or applied directly to it. This high frequency current, becau e of its high voltage is able to take a direct path through the tissues and is not greatly affected by their relative resistance takes the direct rather than the easiest path one mucht say

We have spoken of the general construction of the d'Arsonval apparatus and the manner in which this current is generated Before con sidering its specific local and systemic effects, it would be well to have in mind some of the qualities pos essed by this type of current A current oscillating at this extremely rapid rate of approximately a million per second is too rapid to institute ionic movement. There is therefore, no muscle contraction, no ionizing effect but only sedation and the

development of heat

Local Effects -There is produced a very mild hyperemia of the akin increased activity of the skin glands beneath the electrodes and lessened skin sensitivity. Increased cellular activity of any given gland in the pithway of the current is produced with no tetanization of muscle, with a proper technic. The sedative effect upon nerve endings has been demon strated by decreased pain and diminished electromotor responses. Active arteriole and capillary dilatation follows This increases the local arterial blood supply mere uses the amount of lymph passing into the tissues and quickens the venous return by lowering the capillary resistance to the blood stream Nearly all these effects are directly proportional to the amount of heat produced, and this depends again upon the size and type of the electrodes used the amount of the current and the length of the treatment Heating is intensified during the latter part of the treatment

General Effects -The distribution of the heat by the body fluids raises body temperature somewhat from 5 to 2 o F There is a lowering of blood pressure, with mild general stimulation of the processes of metabolism and especially of elimination. With heavy currents there may be a general feeling of lassitude and ometimes fatigue, especially in elderly persons. A quickening of the pulse rate is often noted and a general increased activity of the climinative mechanism

Experiments -- If the autocondensation handles are held in either hand when the current is turned on, the wrist becomes warm with a

stronger current the arms and shoulders become hot and the wrists very hot and eramped

- 1 Cumberbatch noted the following temperatures in a patient using this technic with 400 milhtampers for 20 minutes. There was a rise of temperature. Fibienheit, as follows front of the wrists 6°, front of the clow 4° avilla, 24° mouth, 26°, group, 12°, and pophical space 3. The rise of temperature in the mouth and in distint parts was due to the heating of the blood stream, and the naturation temperature was in the wrist where the current density was grayted.
- 2 In a second experiment the same technic was used with 500 milliamperes to meximum tolerance, which give a temperature in the front of the wrist of 20. The flower side of the arm was 3 to 4° warmer than the extension side which increased to 6° when the arms were fixed. With the electrodes over the chest and abdomen, no rise of body temperature was secured.
- 3 D broom il demonstrated that all parts of a siline solution were equally heated. He further showed that in presing disthermy along the hind legs of a ribbit the deeper tresses as well as the skin, could be consulted by stong currents.
- 4 Wan, have pused distherms through the thorix of a dog in which a small electrical lump had been placed. The lamp became undergot
- of saline solution to the druthermy entrent. Strips of her were cut to be 10 hi linels. In each case 460 milliampers were used for four minutes (a) Crook's metal electrodes 4 inches for, and 1 mely wise were wrapped around both ends the liver placed in a dry dish and the current turned on. The liver was thoroughly cooked through and was especially well done in the center. (b) Both liver and electrode with placed in the silt solution and the cooking was very much less marked (c) One and wis raised as before the other end placed on the electrode on the bottom of the dish. The liver was cooked except on and under the electrodes (d) The fric electrode was simply placed over the electrode of the dish down into the saline and the results were the same in C, but the cooking not quite so thorough. These experiments indicate that the direct application of plates is more efficient than through the water but that a true disthermy may be obtained through saline into which in electrode has been placed.
- 6 Cumberbutch describes a case in which the pulms were moistened with saline and the thermometer placed between them. The electrodes are applied to the back of the hands. One thousand four hundred militangers for six minutes gave a 7° F. rise of temperature. It is to be noted here that we have two extra layers of skin with their added resistance and the rise of temperature is therefore greater than it would

be in the middle with the same mas of tissue, as, for instance, in the foreign

- •• In a lar,e growth on the back of the neck, with the indifferent electrode on the cheet, an active eircular electrode three-fourths of an unch in dimetre, wis placed on the showth. A thermometer was thrust into the growth one, included the active electrode. The temperature rose to 110 F.
- 8 Illustrating ed e effect. When two electrodes are placed sude by sude or end to end the bottest point is between them. Two electrodes were placed on the lack of the fourirm the market edges are indiquent. The temperature of the kin under the center of the plates to e. 8. I on the elge framp the opport telektrodes, 21. F.
- 9. Saliction experimented with a dash of eg. albumin. Two cleetrodes were pleed in the albumin at opposite sides. When a heavy current was turned on suddaily the cogulation first appeared immediately beneath the electrodes. When turned on slewly coagulation took place first in the center.
- 10 Hertible metal electrodes were bound on the opposite sides of a large potate. Fifteen minutes of moderatels strong current were applied. The potate was cooked in a diamond shiped area, broade tim the cuter.
- 11 The temperature of the bram can be ru ed by duthermy through the shall. Glocity and Waser's showed 1. Crease in the lateral ventricle

of a do, after distherms for tin minutes

From our clinical experience with this current and from the foreguin, experiments we may conclude.

- 1 That disthermy does desclop a deep-seated and real heat within
- 2 While this heat is great enough to congulate protein, there is no danger in its application to normally vicularized tissue, because the circulation of the body fluids diffuses the heat

The amount of heat developed depends upon the resistance of the trees and the current density. With a given milliampurize the current density is equal if the electrodes us of the same size and the greate tamount of heat is obtained hidrest between them, when the current is showly turned on If chardest of mengal up are used the current density is greater a hort hit time below the maller electrode. Thus we are alle to localize the desired effect. In the application of duatherms tithe majors or toes advants a may be taken of its condition through salt solution.

The Machine —To give satisfactors distherms treatments an apparatus must be capable of dilivering at hast 2 000 milliamperes of cur

Ar h f Exper lath u 1h rm & Jun . 1914

rent Fortunately, there are several types eastly portable which are of sufficient power. The larger machines for office practice are most economical when built exclusive of many seldom used attachments. As true sumsodal current can be derived from a high frequency outfit in spite of advertisements to the effect.

When the appractus will not work, first see that every switch is clo ed and the will plug fully in cried. Next, test the circuit outlet with a lump or other piece, of apparatus. If the trouble lice elewhere examine next the spark gap taking it apart, cieauing and rearranging it, if it is of the DeKraft type, or using emery cloth on the double button variety. Further taking down of the machine is inadvisible, except in expert hands. Most manufacturers are providing good repair service where possible

Electrodes — Vanv types of electrodes are now on the market. Crook so r composition metal, twent two gage, are perhaps the bast for gueral use. These may be cut into convenient sizes and shapes. All four edges should be turned sharply back and rolled flat. A slightly louger flap left on one end will facilitate the nitiachment of the clup beveral electrodes should be prepared to fit easily over curved surfaces, such as the point of the shoulder. This is done by shitting the side or east of that overlapping is possible. Lighter weight metal is sometimes used. Tuifoil is very convenient for use on the phylangical joints with small amounts of current. I prefer varieties of twenty two gage metal for reviews have

The solid steel disc type with handle is inflexible, requires holding in place and can only be used on flat surfaces. A new type of electrode cours ting of wire me hove soft material supported by a solid metal hick and applied in means of a retaining handle, has just been brought out. With this handle a pair of electrodes may be quickly applied to the opposite sides of ankle or knee and will remain firmly in place German silver mesh may now be purcha ed in required amounts and quite durable pads mado with it. In some modifications of diathermy the autocondensation pid, vacuum or non vacuum high frequency electrode or hand of the operator or putent are connected to one d'Arsonal terminal and act as an electrode.

General Technic—The patient must be made comfortable, the part to be treated well supported, and he should, if possible, be 'mentable prepired,' as before suggested The machine should be examined to make sure the spark gap is closed and the rheostat on 'I' Close the lanfe switch to make sure the machine is running It is well to warm the compo inton metal plates by placing them face upward under the radiant light or in very bot water With shaving brush and sorp prepare a heavy, hot soap lather and, applying it freely over the electrodes place them on the shin. Attach the metal cord tips with clus

or simply place them on the back of the electrodes and bind them firmly with elastic or cotton webbing or rubber bandage

Inspect again the attachments of both cords and then close the machine switch. In the sverage treatment, from three to five minutes should be taken to raise the current to maximum, and two or three minutes used in reducing it. This may be done by the following method when using the Dehraft grip. Open the spark gap slowly one or two notches it may then be closed one notch and the rhoestat switch placed on the second button, when it is again slowly opened. After a moment this procedure is repeated until the third fourth or if the little on the incostat, as desired, is reached and the spark gap on the second third or fourth notch gives the desired maximum current. This procedure should take not less than four munities for its completion.

With the hooded tungsten or turn-serew type of gap it is often possible to place the rhoostat at the desired position for maximum treatment and to depend on the very gradual opening of the spark gap above to gradually increase the current strength

It is desirable to take about one-half as much time in reducing the entrent as was consumed in raising it to maximum. Neglect in the use of the requisite time for both of these measures may result in painful and generally implicasing sensations on the part of the patient

Where it is desired to localize the heat near one surface, select electrodes of unequal size. The current desires and heat production is greatest beneath the smaller electrode. When plates of the same size are used the heat is generated in the center of the tissue mass between them Less current is always required in dense tissue, such as the knee-joint them through less denies tissue, such as the knee-joint them through less denies tissue such as the abdomen. It should be remembered that, since the hert varies as the square of the current in any givent tissue density a slight increase in the milliampère needle reading will give a marked rise in the ulternal heat produced. This is the reason why some pitients are sensitive to what seems to be but a slight increase of the current.

In normal tissue with good contret, it is safe to use 100 milliamperes of current for each square meh of the amaller electrode. In very vascular tissue and where the resistance is especially low, this allowance may be increased, of per cent. The patient's essantian is a reasonably good guide. When, bowere one is treating, anethetic areas extriprecaution regarding both the contact and the current strength must be taken. Patients having arterioselerosis must be treated with extreme caution. Their vascular elisticity is impaired and their heat diffusion sliggish. A thicky red evithema moder the electrodes is a harming that the current strength must be reduced in subsequent treatments. When a pair of plates are need on opposite sides of a limb or other aimilar situations, it is of the utimost importance to see that they are equidistant

at all points. When this is not done, an undue current density is developed between the near points which may cause a burn. Such a situation may arise, for justince in the knice, by the pitient changing his position after the plates are properly placed

The patient is maware of the degree of sensation the treatment should produce Hence be should be instructed to inform the operator at once of any puticular points of heat or faradic sensation When these unpleasant sensitions occur, turn the current slowly off, remsert soop lather with brush or finger, press the electrode down firmly a that point, reapply the bandage, and slowly mercuse the current again

When the current has been cut off completely by slowly reducing the current, remove the electrodes and carefully dry the skin. There is no danger in the patient going outdoors with reasonable protection, by the

time he is dressed and ready to leave the office

Special Technic-Ance -I storil plates, while parallel, should be placed slightly nearer the front than the back of the joint, due to the sensitivity of the skin in the popliteal space. Some operators "ero s fire' the joint by using first unteroposterior and then lateral plates

Another method of reaching the moint surfaces is to fier the joint

fully, placing one plate below and one above the patella

Heart and Lungs -Use fairly large plates, perhaps five by seven inches, and turn the current on and off with great one A steady current, as shown by a stitionary needle on the milliamperemeter, must be used It is unnecessary to bind the plates on, as the principle may lie on the posterior one while the other is held gently but firmly on the chest

Brain.-Diathermy of the brain has been successfully used in a number of conditions The electrodes may be applied to forchead and occupit or laterally through the princial region. It is necessary to complex a current of abolite steadiness. One tiken from a machine where there is the slightest to and fro movement of the meter needle is unsuitable. Not more than 500 milliamperes should be used for a maximum of fifteen minutes Lxtra cure and time must be taken in increasing and decreasing the current strength

Spine -It has been a common custom to apply two long, narrow electrodes to either side of the spine I do not believe that any thermal effect on the spinal cord or vertebral articulations, and but slight effect upon the erector-spine muscles can be obtained by this method, because of the edge effect The major portion of the current passes along through the skin and the subcutaneous tissue between the near edges of the electrodes It is our custom to truit such cases by having the patient he prone upon the autocondensation pid, using a movible, non vacuum, surface electrode over the spine

If more convenient, one long narrow electrode over the spine may be substituted for the movable electrodes We thus localize the heat constantly under the electrode, obtaining the greatest current density in the structures beneath it

Extremities -A direct current may be used by applying two vacuum or non vacuum electrodes to opposite sides of the elbow or hand, for in tanic keeping there constantly in motion. This might be termed a movable, direct technic and is useful in the elbow, on the fingers hands and feet. The hands and feet can also be treated through saline solution In treating one of the proximal joints of the fingers one metal plate is bound around the midfore irm the other placed in the bottom of a non-conducting ve-sel filled with saline and the fingers immersed in the solution Then the current is turned on and a strength of 500 to 600 milhamperes used After the other tangers are withdrawn one at a time the patient feels the increased density of heat in the affected finger which is greatest when all the other fingers are railed. If the heat then becomes too great, a second fin er is replaced in the saline. This technic has the adventage of being entirely under the patient's control and he soon learns to regulate the amount of heat he is able to endure in the affected finger. If it is desired to treat the wrist, the whole hand may be placed flat on the bottom of the retainer. The foot is treated in a similar fashion. For the treatment of the hand and writ, if the flugers are flexible we use a technic unilar to the above, except that the patient holds the autocondensation hindle in the hand instead of immersing it in the saline

Another technic in general u.c. is the zone or cuff method for treatment of the extremities. For instance in treating the elbow one electrode encueles the upper iring the other the forearm. It is behaved that most of the current is pa ed along the mu cles, tendons and subcutaneous to sue and that comparatively little is obtained in the mont itself. It is true that this skin or zone effect is diminished if the electrodes are widely separated or between currents used but, if it is the ellow or the knee that is affected the through and through technic fir t de cribed seems more efficient. For the sharp localization of heat clos to the surface as, for instance in the gums following dental tranm; or over the temperomaxiliary region I leanor Volkmar of Wa h ington has suggested placing the patient on the autocondensation on hion. The operator holding an electrode in one hand makes quick contact with the whole hand, then using the fingers as rheostats concentrates the heat beneath the tip of one finger. We have modified this method by placing the operator seated on another autoconden ation pad giving more freedom in the application of the treatment. A knowledge of the threes involved and the therapeutic problem at hand will enable one to still further modify the technic along rational lines

Autocondensation —This technic of general disthermy is in common use. The patient is cuted or lies prone—the latter preferred—on the

autocondensation mattress or pad This cushion is attached to one d'Arsonval terminal and the steel cylinder electrode, attached to the other terminal, is held firmly in both hands From 600 to 800 milliamperes are given for twelve to thirty minutes



Fig 10 -AUTOCONDENSATION FOR HIPERTENSION

Precautions —There may be improper contact between electrode and skin

The current concentration may be too great, as when there is a near approach of two plates at some point

Because of local anesthesia the patient may be unaware of a degree of heat approaching pain

The tissue vascularity or visomotor mechanism may be subnormal

as in scars and arteriosclerosis

Contra indications — These are very few in number and include

Inflammatory conditions associated with walled in pus

Conditions where there is danger of instituting hemorrhage such as pul monary tuberculosis with cavity formation and gastric or duodenal ulcers

Phlebitis usually classed as a contra indication, has been distinctly belped by diathermy in several resent cases with no untoward results

## SURGICAL DIATHERMY

Definition —Surgical disthermy is the destruction of tissues by raising and localizing heat within them to the point of congulation or desiccation. It has also been termed disthermic canterization, but differs from other types of cauterization in that the heat is generated in the tissues instead of being conveyed to them by conduction

It differs also from chemical galvanic cauterization, which is caused by the concentration of cau tie ions at the poles

The chief advantages of surgical drathermy over other operative procedures are

- 1 Certain tumors otherwise inoperable may be removed
- 2 This procedure is practically without hemorphage making it of special value in conditions such as cancer of the tongue
- 3 Danger of spreading metistuses is much less than with the use of the kinfe, because the blood vessels and lumphatics are sealed in the procedure.
  - 4 The field of operation is sterilized by the heat developed
    - 5 Surgreal shock is in many eases less
    - 6 The operation is rapid and often not difficult
    - 7 I ostoperative adhesions are seldom formed

Among the chief disadiantages of this procedure may be mentioned

- 1 The operator cannot have important structures such as nerves, arteries and years as he does in blunt dissection
- o hormal tissue is ilestroyed along with the malignant tissue in the
- same area

  3 The danger of causing hemorrhage when performing surgical
  diathermy near large vessels is obvious
- 4 The liability to form keloids, in operations where large areas of skin are involved, is great
  - 5 The tissues must be easily accessible
- 6 Patients who are extremely weak do not stand this procedure well.

Technic —We are largely indicated to William L. Clark of Phila delphia for the development of the technic of desecution. A general anesthetic is insually required. The indifferent electrode insually a large flevible composition metal plate is well lathered and applied with the same care as in medical disaftering. On must be sure in a prolonged operation, to keep plenty of soap under this electrode. After the operation is completed the patients kin is dried and powdered. The activo electrode consists of an insulated handle with metal center to which needles or a group of short needles kinves buttons and various other attachments can be fastend.

When the apparatus and electrodes are in readines the current is turned on and the knife or button is pressed firmly into the tissue to be destroyed From 1,000 to 2,000 milliamperes of current are used. At first, bubbles of sterm and gas are given off and, in the very short time it takes the tissue to coagulate, usually a few seconds, sparks will jump from the electrode to the surrounding tissues, at which point the current should be instantly turned off. Intense contriction of muches and undire stimulation of surrounding nerves occur, if the treatment is prolonged. When the current is turned off after the appearance of the bubbles, the tissue is congulated. The tissues are coagulated to a depth roughly equal to the diameter of the electrode and in cross-section about half its diameter beyond the edge of the electrode. When the needles are used, the depth of congulation is much greater, but not as great in the cross section. The less viascular the tissue, the more quickly will be coagulation occur. When large masses are to be congulated, it is need sary to prevent too sudden drying, by dropping salt solution constantly along the electrodes.

It is believed that this procedure is of sufficient value to justify the addition of this apparatus to the equipment of every modern operating room.

### UNIPOLAR HIGH FREQUENCY CURRENTS

Tesla and Oudin Currents—One of these two types of simple monopolar high frequency currents is generally combined with diatherms in single apparatus. The general physics of the current is somewhat the same. The Tesla transformer consists of a secondary coil wound around the solenoid for the purpose of raising the tension of the current. The Oudin resonator is made of a coil wound vertically on a solid base. Coils on the resonator acting as the primary high frequency solenoid, and the remaining coil by resonance, thus arranged greatly merce as the voltage. Condensers in these types of current may be of the plate type de cribed under diathermy, or Levden jars. The former has been described.

Leyden jars are containers nearly filled with saline. They are made of glass, lined inside and out with metal which becomes the arms tures, the glass acting as the dielectric. The inner side is connected to a rod or chain, the outer grounded. The inner cost is charged by the high tension coil producing a charge of the opposite sine in the outer cost. A metal conductor from the outer cost near the rod to the inner cost forms a spark gap and discharges the jar. In the common Oudan reconntor, the voltage of the current can be raised sufficiently to produce a strong violet brush discharge, in glass vacuum or non vacuum can denser electrodes.

Vacuum Electrodes — Vacuum electrodes are known as condenser electrodes The current carried to them by a cable charges the vacuum

and mer surface of the electrode and a corresponding charge is induced in the outer surface of the glass. The current induces a violet-colored fluorescence within the vacuum. When brought in close contact with the skin the electrodes give a brish discharge of slightly warm and stinging character. If they are kep in contact with the skin and moved rapidly, the skin becomes warm ind hyperenie. Vacuum electrodes of thin glass, of various sizes and chapes for surface and cavity work and shaped to a common insulated handle, are supplied by the minimum futurers of the various machines. The electrodes tend gradually to loss their vicuum and to known less and kes efficient, but are furly

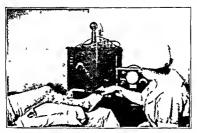


FIG. 11 -THE APPLICATION OF STREAM HIGH PROPERTY

inexpensive to replenish. They have been known to explode and break in fine particles during treatments

I dward C Titus of New York has been doing ome valuable work with electrodes filled with belinn grs. This work seems to indicate that an electrode of high efficience and durability may in time be produced in quantity and form is shadle addition to our apparatus.

A non-vacuum silver lined and insulated handle electrode has been produced of a much higher effurince than the common vacuum type. This product is on the market in every form and varety. It is still slightly hort of tructural perfection trading to oxidize after a certain amount of use. But all things considered I believe it to be the most effected tectrode now at hand.

Physiological Effects—Locally a counterpratant effect upon the skin is produced which is greatest at the edges of the moving surface electrode and increased by the widening of the spark gap. Heat is produced in the tissues immediately beneath the electrode and to a variable depth, depending upon the strength of the current. This combined effect stimulates greatly skin cell metabolism and the activity of the skin glands The general effect is due to the fact that the body is completely charged and discharged with each oscillation of the current, as proved by a spark nump to a second person, if near contact as made. This effect is similar to, but slighter in amount than, the systemic effect of diathermy, that is, there is a very slight warming of the body, a relaxation of ten sion and a general stimulation to all cell metabolism. It is not as a rule, used for this general effect but only in local heat production, the stimulation of the skin and closely underlying tissue being the usual indication for its use. The two types of current differ but little in their effects

Technic -The spark gap and rheostat are started at zero See that all connections are tight, the electrode firmly attached the skin dry and powdered In nervous patients apply the electrode before opening the spark gap one notch In addition, the first time the patient is treated it is well to let him first try the current on the palm of the hand, before applying it elsewhere. The reason for using powder is to take up the amount of perspiration developed and to enable the electrode to slide easily over the skin Wost cables when new, can be held to the handle of the electrode in the grasp of the operator When the insulation is worn, as often is the case they should be held free from the patient's body and close to the handle of the electrode by a loop of bandage, handlerchief or towel

It is annoying to the patient to have the collo brushing the skin, but, even though the insulation is poor, he will receive no spark from the cable while the electrode is in contact with his skin. When the electrode is being applied or removed, he may receive a hot spark from some part of the cable touching the skin, producing a burn The electrodes should be cleaned with warm water after each treatment, being careful in the non vacuum type not to get water into the electrode through the opening for the metal loop on top With the skin powdered and the electrode in place, the spirk gip and rheostat are gradually increased to the desired strength of the current

In general this current is useful in producing hyperemia through its thermal effect in the neck, the joints of the hand and foot and other superficial tissues, where diathermy electrodes are difficult to apply It is useful, as stated for stimulation of the skin glands and, to a slight degree, for general stimulation along the spine In the latter case a wide spark gap and low rheostat is used. If the current is on before the electrode is applied to the skin it should be applied very quickly. kept in fairly rapid motion, the excursions of which must be great enough continually to cover an entire new surface of skin, otherwise some of the electrode is in con tant contact with the same area of the skin, re ult ing in overstimulation. The electrode may be removed quickly with the full current on. It is not neces are as is the case with diathermy. eradually to work the current down before discontinuing the treatment

The subject of high frequency should not be di mi ed without a word regarding the mall toy machines with which the country is flooded.

Efficace in the treatment of almost every ill the ficely is her to is claimed for them If potent as claumed they would be dangerous in the hands of the lasty. There can be no question that they have the danger of other similar procedures, that of delay in proper diagno is and treatment of conditions where such delay may be errous or fatal to the nation. This cheap type of apparatus has only a low frequency of oscillation, no resonance or quality of current The current it produces re-embles the rich smooth powerful current of a well made machine in the same way that the tone of one cheap fiddle re embles the combined strings of the symphony orche tra It is a afe rule in electrotherapeutic practice, as el ewhere, that the best work can only be done with the best tools

### STATIC ELECTRICITY

Definition.—Static is a form of electricity of extremely high voltage and low amperage. It is developed by friction is hard to insulate and has distinct polarity

Uses -Static was cla sified under the mechanical currents By means out twe are able to produce mild and superficial or deep and powerful contractions of mu cle ti ue which is to some extent hared in hy other types of cells so that it has been at times called cellular mage. By means of no other currents or combinations of currents nor he the use of any other type of physiotherapy can like effects be produced to the ame degree In routine office practice there are a number of di advan tages in the u e of this current among them are

1 The expense of a well made and turdy type of machine

2 The amount of room es ential to its proper u e

3 The awe and dread which the ize and power of the apparatus provokes in the uninstructed in this really most safe of all currents.

4 The exploitation of the undoubted p-vchological effect of this cur rent by those who do not understand it or its legitimate uses

History -We are indebted to the late William J. Morton, who first used static about 18-0 and more recently to William Benham Snow Frederick DeKraft and Major Chris M Sampson of this country and W J Turrell of England for the further introduction and standardiza tion of static electricity in therapeutic practice

in the tissues immediately beneath the electrode and to a variable depth, depending upon the strength of the current. This combined effect stimulates greatly skin-cell metabolism and the activity of the kin gland. The general effect is due to the fact that the body is completely charged and discharged with each oscillation of the current, as proved by a park jump to a second person, if near contact is made. This effect is similar to, but slighter in amount than, the systemic effect of disthermy, that is, there is a very slight varioung of the body, a relaxation of tension and a general stimulation to all cell metabolism. It is not, as a rule, used for this general effect but only in local heat production, the stimulation of the skin and closely underlying tissue being the usual indication for its use. The two types of current differ hut little in their effects.

Technic —The spark gap and rheestat are started at zero. See that connections are tight, the electrode firmly attached the skin dry and powdered. In nerrous patients apply, the electrode before opening the spark gap one notch. In addition, the first time the patient is treated it is well to let him first tirv the current on the palm of the hand, before applying, it elsewhere. The reason for using powder is to take up the amount of perspiration developed and to enable the electrode to slide easily over the skin. Most cables when new, can be held to the handle of the electrode in the grasp of the operator. When the insulation is worn, is often is the case, they should be held free from the patient's body and close to the handle of the electrode by a loop of handage, handkerchief or towel

It is annowing to the patient to have the cable brushing the skin, but, even though the insulation is poor, he will receive no spark from the cable while the electrode is in contact with his skin. When the electrode is being applied or removed, he may receive a bot spark from some part of the cable touching the skin producing a hurn. The electrodes should be cleaned with warm water after each treatment being careful in the non-vacuum type not to get water into the electrode through the opening for the metal loop on top. With the skin powdered and the electrode in place, the spark gap and rheostat are gradually increased to the desired strength of the current.

In general this current is u eful in producing hyperemia through its thermal effect in the neck, the joints of the hand and foot and other superficial tissues, where datherniv electrodes are difficult to apply. It is useful as stated, for stimulation of the skin glands and, to a slight degree, for general stimulation along the spine. In the latter case a wide spark gap and low rheostat is used. If the current is on before the electrode is applied to the skin, it should be applied very quickly kept in fairly rapid motion, the excursions of which must be great enough continually to cover an entire new surface of skin, otherwise some of

damp weather, ice and salt may be used to condense what moisture has gotten into the mechine. It is advisable on dry, sunny days to take off the ends of the case and admit fresh dry air. A yardistick wrapped in cloth and dumpened with banun oil will clean und remove all moisture from the plates. After several applications, however, a film may form on them which requires removing by seraping. Each day the rods and terminal brills should be gone over with hot flannel cloths keeping them bright and dry.

Charging —Place the charger chain on the opposite terminal after the ground wire his been removed. Turn down the charger rod sepurate the mall terminals about half or three-quarters of an inch and turn the charger handle rapidly. After several minutes of spark discharge across the terminals turn on the motor. If the spark discharge keeps up after charging rod and chain have been removed and continues when the terminals are eparated two or three inches, the machine is properly charged. It may be necessary to repeat this procedure several times. If still insuccessful attention must be given to changing the air made the case or cleaning the plates.

Folarity — Static is another type of current in which the polarity ef fects are distinct and of great importance. There are three convenient tests for polarity

With a spark gap of about three-quarters of an inch it will be noted that one end of the stream of sparks appears light in color, this denotes the postine pole

When the terminal distance is increased to three or four inches, this light color appears at the negative terminal

Perhaps the most relyable test is to separate the terminals some four inches run the machine at full speed and approach the terminal with one end of a dry wooden stick. The most convenient rod to use is one from one foot and a half to two feet in length. The stream of sparks at the positive pole will follow the movements of the end of the stick at the negative pole it will not. The differential polarity effects will be stated in a description of the separate types of current.

It must be kept in mind that the polyrity may become reversed While this most often happens when the machine requires recharging it will occasionally happen from dampness without appeared complete loss of charge. No static treatment should ever be given without the operator scertain knowledge as to its polarity at that time

Physics and Physiological Effects—The best types of apparatus developed a voltage ranging from 100 000 to 800 000 and an amperage of from 1/4 to 2 milliamperes. This extremely high potential and minute volume of current is not approached in any other type of electricity. As stated the main effect is that of tassue contraction not alone confined to muscles

The current is diffused easily rapidly and completely

Apparatus—The two principal types of static machines built in this country are, in the opinion even of foreign workers, superior to any nade abroad. They counst of two separate compartments, in the smaller of which two revolving glass charger plates with breas brish collectors are placed, turned either by hand or motor. In the larger section are a series of glass or fiber plates arrunged in pairs and revolved practically always by motor power. The size, number of pairs and possible speed of the plates, all are determining factors in the efficiency of the anomatics.

The type of machine having been cho en, the next thing to consider is its location. The static muchine should be placed, if possible, in a room by itself and in any event, at as great a distance as possible from the walls and other apparatus. A point emphasized by Sampson is the proper grounding of the michine. He stites that a ground were should be suspended at least three feet above and one or two feet in front of the machine and should not come nearer than this distance to it In this way leakage is reduced to minimum. Connection from the ground to the machine may he made by using a piece of heavy copper wire three or four feet long with a flexible chain and book at the lower end for attachment to the proper pole of the apparatus. It must be so arranged as not to swing clo e to the other pole of the machine or to the patient on the platform The other end of the ground were may be connected to a radiator or water pipe or to a copper rod driven into the ground Both the end of the ware and the object around which it is twisted should be freshened with emery cloth and the connection made tight by several turns or by soldering Loose connections quickly oxidize, offering in creased resistance to the grounding of the current and interfering with the efficiency of the apparatus The ground wire should never be attached to the frame of the machine nor laid on the floor beneath it, as in that way serious leaks of current are apt to occur

An insulated platform of wood with glass legs should be provided.
While any wooden chair may be used, it is most convenient to have one
of the adjustable reclining type made entirely of ration in which he
steel or other material is used. A second grounding must be made by a
flexible chain which will reach to the treatment platform from as nearly

as possible the opposite direction from the machine

Gare of Apparatus—The made of the case mu t be kept as neutral dampproof as possible by tightly fastening in each section of it. In addition it is necessars to keep dryng material miside of both charger and plate sections. We use for this purpose wooden boves, lined and covered with unbleached muslin and filled about hilf full of dry lump lime. The covering prevents the lime powder from being distributed through the machine. When this lime has absorbed moisture and has swollen to the size of the box, it should be refilled. Thrirell uses for this purpo e shallow basins partly filled with sulplanne and. In puricularly

Morton Wave—The wave current has been termed ionic, molecular and mass mi sage. It is dependent for its effects upon the very power ful and extremely penetrating whertions produced. This perhaps most valuable of strite modulities was first de cribed by Morton in 1890. It is a decongestor of tissue removing and to some extent, breaking up emdate not yet firmly organized. For deep-tissue drainage in form of massage or contriction produced by other currents can approach its efficiency.

Treatment Technic —The negative pole is grounded, and the electrode connected to the pittent is attached to the positive pole. The wave may be given with or without the use of Levden jars. In commencing, the treatment should be moderate and the spirk gap quite short. The best electrodes for general use ure the composition metal twenty two gage recommended for disthermy. A number of these miss be cut in varying sizes and slapes using a clip to attach them to the wire or inserting a hook through a hole mide in the longer turned bed, end of the metal. A broad U shaped electrode to evaluate the patella is convenient for applications over the lance. One electrode may be lift from the middle of one end and overlapped to fit the point of the shoulder. It is not nece sare to obtain the perfect contact required in disthermy, ulthough a reisonably good context und the u e of warm soap lather makes the treatment more comfortable for the patient. Morton wave is never applied over bony prominences.

The physiological effect of the current is modified by a number of factors. The best rate of spark jump and con equent thesia contractions is three to four per second. This rate is munitiated when the spark gap is gradually lengthened by steadily increasing the speed of the plate revolutions. It is customary to find in treatments of tender areas that the putient's tolerance gradually increases so that a wider spark gap with deepened effect can slouly be obtained without increasing disconficient.

The local effect produced is proportionate to the width of the spart, app and inversely as the size of the electrode A good insulation of the platform is e-sertial to the ceiring of a good result. The length of the treatment varies from ten to treat manutes. It is unvise to use the wive current in an attempt to break down organized evulate, such as that following a muscle bruse unless it has been preceded by diatherms. Exudates near the smuller joints and in tendon heaths are better reached by means of the state spark. Such organs as the liver, spleen and pro tate may be easily and efficiently treated with the wave current

Sparks—The sparks are applied to patients by the direct and indirect method. The direct method is not as efficient is more stinging and painful and used only to reach deep-seated lesions. The platform is connected to the negative pole the positive side grounded. The ball elec-

throughout the entire hody and through the air and other relatively poor conductors. This diffusion is dependent upon the second main quality of the current namely, its tremendions voltage or potential and is shown by the raising on end of the hair, and in many other ways. This raising of the hair is due to the fact that, the hair being charged with the same polarity as the rest of the body, its free end is repelled by this like charge. In the contraction of muscle tissue it is not necessary to pay any attention to the motor point as the perfect diffusion and high potential affect the entire muscle and easily produce a good contraction. I have spoken in other sections of the often neglected but important point of reassuring the pittent especially when, for the first time, an electrical current is applied to him. There is no type of current in which it is so essential to perform this duty as it is in the case of those derived from the static machine. To carelessly inform a patient that he is about to receive some half nullion volts of electricity, without explaining the freedom from danger which the minute amperage of state assurize, is to be unfair to him. Absolutely no ill effect, other than an unpleasure that principle of the park is a cold one. The haud may be held between the terminals with impunity. Matches cuinot be ignited in the pathway of the spark again, I repet, it is it he safest of all electrical modulities used in medicine

When giving sparks, I often explain to the patients that it has a slight stinging, character, quite similar to snapping an elastic build on the skin, with no burn or after pun. It is often found that pun and tendernies from previous tissuo engorgement is so greatly relaxed that patients request more sparks rather than fewer. The other types of statio if properly given, are not in the least unpleasant. Some writers advise giving milder types first, even though they may not be as efficient in order to accusion a nervous patient to the apparatus before using spirks. I have found this unnecessing them to the required severity. This contractile effect is that of pructically all types of static modalities and their minor differences will be described separately under each type.

All static modulities raise blood pressure somewhat and should be avoided in cross of marked hypertension. Its employment in low systolic pressure and associated conditions is distinctly indicated.

The patient should remove all steel which touches the skin clasps, hairpins and steel ribbed corsets should not be worn both operator and patient should lay used their witches during treatments

## MODALITIES

The different types of current derived from a static machine include wave, sparks, effluve, induced, and simple charge

sprains without rupture of ligaments, are improved with astonishing rapidity. A certain general toning up effect upon the general nervous system follows a treatment of sparks along the spine

Effluve —The stitle effluve bru h blue penell or breeze, produces extremely mild and more or less superficial contraction of tissue. Its effect is alisticated sedictive when jiven by the ordinary method. It may be made rather irritating when the electrode is applied closely or through the clothing. The sensition which the patient receives is that of a cool breeze striking the skin.

Treatment Technic.—The terminals should be opened to their fullest extent. The positive side is grounded. The shepherd crook held by the patieto or placed on the platform is connected to the negative pole. Quite a variety of electrodes hive been used in giving this form of treatment. The DeKraft pened is to be preferred for all general use. It consists of a fiber cylinder filled with asbestos, at one end of which is a blint brias point and at the other a ring for connecting it with the scond round chain. Willow or ash stucks have also been used. Where it is desired to diffuse the effect produced an ordinary which broom may be used as the electrode. A loop of the second ground chain should held in the grasp, while the electrode or the chain may be partly wrapped around the operator a bodt. The point of the electrode is lid. at a varying distance from the skin, depending upon the amount of current, usually about three inches and and moved rather rapidly by the flexion and extension of the wrist.

Boudet of Paris found that the area of superficial skin effect was about one and one-half times the distance between the electrode and tho body Therefore it is concentrated by close approach. The bluish color which appears between the point of the electrode and the skin is probably due to electrified dust particles which become fluorescent crown piece with brass points on a stand may be used to localize the effect on the head, and when given to women patients all combs and hairpins must be removed and the hair should be braided. It should be placed quite a few inches from the top of the head. The effluve current is especially useful in acute nerve pain to gently remove tissue congestion over bony prominences and in locations where wave and sparks are diffi cult to apply A typical example would be its use to promote absorption of the hemorrhage in a case of black eve The use of it to promote the healing of ulters has been recommended but this is better done by other means Headache and insomnia particularly when associated with low blood pressure are amenable to treatment by the static effluve

Induced Current—This type of current first described by Morton, is also used to drain tissues. It is applied by the bipolar method the patient being connected with the outer two coats of the Leyden jars the inner coatings of which are connected to the terminals. Its local

trode with handle is applied from the second ground chain for direct sparks

Indirect Sparks—This is the method commonly used — Its effects are much more sharply localized than with the wave current, but the effect of muscular and cellular contraction is much the same

Treatment Technic — Snow connects the positive pole to a metal plate, some ten by fourtten unches placed upon the platform, and grounds the negative Sampson Tirrell and others apply the shopherd crook from the negative pole to the platform with the positive not grounded. In every case the spark is given from the ball and handle from the second ground chain. The intensity of the spark may be modified by varying the speed of the machine, by opening up the main terminals or by drawing off part of the current through the operators foot, piecel closs to the platform or resting on the edge of it. The wider the spirk gay and the faster the machine is run, the longer and more powerful will the spark become. The hook from the second ground chain should be uttached to the ring on the handle just below the bill, and a loop of the chain held in the operator's hand. If the grounding is good, he will feel no effect from the current is applied to the patient, otherwise a light examping of the wrist will be felt, in which case the grounding should be changed.

It is essential to deliver to the patient but one spark at a time A shower of sparks on one area is initially painful Skill in vector plashing this comes, of course with practice, but may quickly be attented if the ball electrode is moved rather rapidly through a semicirele. When this is done, usually only a single spark will occur in that segment of the moviment closest to the patient's shin. One should pase by, rather than toward, the surface being treated. A series of running sparks may be given by rapidly moving the electrode parallel to the surface of the patient's body and at the proper distance from it. Here the sparks on different parts of the surface are not particularly painful. Better to localize the spirk, the loop shaped director, recommended by Sonov, is most valuable. In this case the semiercular movement may be described on the shoulder of the director several inches from the patient's body and the effect is exactly the same.

It adds greatly to the comfort of the patient if the sparks are given in regular rhythm so that he is prepared for the slight shock which they produce Again it should be emphasized that all organized tissue evudates should be treated with some effective form of he it before using sparks. Sparks are extremely implessant over bony prominences, and they should be avoided if possible. The relief form pain experienced after application of sparks to conjected tissue is in a large measure that of the relief of pressure on nerve endings. Musels spasm of many types, with its a sociated pain, is quickly relieved by sparks. Joint

#### CHAPTER IX

#### PHOTOTHERAPY

## HAPRY EATON STEWART

#### LIGHT THERAPY IN GENERAL

History—The application of hight in the treatment of disease is mentioned in the earliest medical writings extant. It disappeared from medieval literature to reappear only shortly before the beginning of the last
century. Among the early writers the I rench took a prominent part
about the middle of the nuncteenth century we begin to find definite recommendations for the use of sunlight in tuberculosis, arthritis rickets and
other conditions. Toward the close of the century. Finsen and Rollier
added much to our knowledge of helotherapy. Recently, work of value
has been done by T. Howard Plank of Chazapo Fágar Mayer, of Saranae
Lake, Major Chris M. Sumpson of New York, Yingil O. kinney of
Wellsville New York, A. J. Pacini of Checapo and others. In attempt
ing to simulate the healing power of the sun Finsen Arons and Cooper
Hewitt did valueble research work.

Physics—It is extremely difficult to divide photother pv into convenint sections since unlight ridant light and to some extent ultravolet light overlap in both physics and physiological effects. A brief consideration, however, of the entire range of light vibrations will form a foundation upon which a short discussion of these individual differences may be based.

There are light vibritions, invisible to the eve but potent in their physical effects at both ends of the spectrum. Below the visible light rais we the herizam waves of extreme length up to several hundred feet with slow vibration rate. These are the agencies concerned in wireless transmission. Next we come to the infrar edo burning rays which range from 900 down to 800 millimierons in kingth and are quite penetrating and heating in their effects. The visible spectrum ranging, through red orange-vellow green blue indigo and violet color extends from alont 800 down to 400 millimierons. Next we cuter the field of ultraviolet radiations. Those contained in unfiltered samight extend down to about 300 millimieron and the superior of the superior

effect is that of the static wave and it has a somewhat general tone effect. It is easily applied to two parts at once such as the two knees or bilteral muscle groups. The ordinary galvanic or high frequency electrodes may be used. The terminals being first closed, and liter opened to the required distance, the patient receives undirectional condenser discharges. It is not really a type of high frequency current, as has often been supposed.

The Simple Charge —The use of the same machine "set" and technic as for efflince but without drawing off any of the current through the second ground chain, products thus type of current. The patient, therefore, becomes highly charged, the current leaving his body by diffusion through the air. Thus current is used to promote sleep and to raise blood pressure and for mild general tome effects.

The writer is aware of the supposed difficulties in the use of static electricity and that it has been land to obtain simple concrete directions as to at sine. He has attempted to supply those. The beginner in the use of static electricity will very quickly overcome his diffidence in handling the machine and become impressed with the results he is able to attain in properly selected cases.

but merely toughens the skin, and that the greater therapeuto results obtained in all irridiation of the e who tan are due largely to the increased absorption they possess to the light rays. I light penetrates easily to an inch and an eighth, some to an inch and a quarter, but in mone of his many experiments did any light penetrate an inch and a half of human twine. He calls attention to the fact that this degree of penetration is sufficient to reach the surfaces of the smaller points, to pass through a thin abdomind wall, and that it will certainly reach sunses, the middle car, some of the mastoid cells and other locations where clinically light has moved to be therapeuterally effective.

Absorption -There can be no question that ultraviolet rays whether obtained from direct similable or quartz lamps, are absorbed by the blood stream and set up photochemical reactions throughout the body which have rather marked effects. The ensitization of cell protoplasm induced by the action of light vibrations on certum cells undoubtedly accounts for the lethal effect produced on bacteria. Sampson was able to affect a screened photographic film applied to one portion of the body after the exposure of another part to ultraviolet light. Vany general effects resulting from exposure to the longer wavelengths, typifed by the red rays are merely those of heating the blood stream although an increase in certain blood elements has been thought by some investigators to be present Similar increases in the red and white cell count, however have been found at high altitudes without exposure to the sun also after irradiation with sunlight or artificial light through glass in which the ultraviolet rava were entirely lacking like increases have been reported Much work remains to be done before the exact effect of light on the cir culation is made clear in detail

Pigmentation—This is to a certain extent a protective phenomenon on the part of the bold etoked by all hight but most intensely proved by the action of ultraviolet light on the skin. The nature and etology of the process is not yet well understood.

With these few general considerations we will turn to the various types of light administration to the body and consider more in detail their differential effects

#### HELIOTHERAPY

Sunlight contains a small percentage of red rays some 80 per cent vellow and green "per cent blue and a small and quite variable percent age of ultraviolet. The ultraviolet rays are easily destroyed or made ineffective by moisture dust and organic matter in the air. They are greatest in amount in the noonday sunlight. They are with the Rasson of the year and in general come through in richer amounts in high clear

microns and the shorter wave lengths derived from mercury quartz lamps range down to about 190 Beyond that hes a field of vibrations as vet mexplored and unknown, then the alpha, beta and samma emantions from radium and, finally, the X ray There is throughout this entire scale a steady decrease in wave length and a corresponding mercase of rapidit of wave vibration rate. It may, in general, he stated that the hertinan waves are the most penetrating, X ray and radium next, then visible light and, least of all, ultraviolet. With the exception that most experiments are modifying our idea of the apparently slight degree of penetralinity with which they have been credited. Many points in the physical effects of light are extremely involved and the writer is only attempting to describe the main effects in the simplest possible form.

Penetrability -Several investigators have claimed that red rays penetrate quite deeply into living tissue Yellow and blue rays penetrate somewhat less and ultraviolet ordinarily do not go far beyond the super ficial layers of the skin Kinney and Shamberg have been able to effect photographic plates through the hand and through the cheek with ordinary incandescent light. By far the most painstaking and accurate experiments in the penetration of light have been done by Virgil C Kinney and a thorough understanding of this subject is bardly possible without and a thorough understanding of this subject is hardly possible windows as a samining, at some length his results. He built a lightproof box and with the use of carbonized putty was able while using it, both with the photographic film and the fluoroscope, to exclude completely all light zo coming through the part under examination. In using the body of a fish he found the usually behieved order of penetration, greatest with red rays and least with ultravolet, to be reversed and he concluded that there would be a uniform increase in penetrability from the red rays clear through to the X ray increasing in proportion to the rapidity of ubri tion, except that the shood acts as a red filter screen especially to handi cap the ultraviolet band. The conclusion has been confirmed by demon strating the penetration of the ultraviolet ravs with compression of the tissues, thus creating an anemic area in front of them Light does not penetrate directly in proportion to the candle power, although with the more powerful lights it is somewhat greater in degree than with weak lights Natural sunlight gives a greater amount of ponetration than any artificial rays, except radium and X ray Of unusual interest are the results he obtained in the relative penetration of light through three hands from blond, brunette and negro which calipered to exactly the same thickness In both fluorescepte and photographic tests the potertation was greatest in the negro less in the brunctte and least in the blond individual. The human retina can detect light ravs coming through which do not fog any photographic plates at present obtunable. He concludes that pigmentation is not a protective mechanism against light penetration,

much more than the light or anburn type. The initial exposure is roughly four to ten times that of quartz light and should vary from twelve to thirty minutes with five to ten minutes daily increment in the e-pitients whose tolerance is built up ripidly by training. Another method of get ting the patient accustomed to the treatment is to zone the body. Expose the leg, then leg and thigh then the hips and so on until the entire lody, front and back, his been exposed. Maximum time may be extended to severil hours with those who tan readily. A cool sponge bath and brisk rubdown with a rough towel should follow all general treatments (for further details see article b. Prior).

Mirrors may be it ed to concentrate the light effect in a shorter space of time. Direct exposure of the chest is avoided where there is any fever

Indications—Hehotherapy will be found mot valuable in those localities where the sun is shining a large part of the time and where it arws are richest in ultravolet halit. It is indicated in practically all forms of tuberculosis with the everptions noted above, in rickets, anemia and certain slow healing wounds. Or time investigators found that good results were bein, obtained in tidly infected wounds in sections of South America, even in spite of lack of servenin. Major calls attention to the part the air Dath plays in the healing process

Ontra indications —There are a number of conditions which either absolutely contra indicate solar viradiation or modify very materially the amount of dosa, cordinarily given. These conditions are

Active pulmonary tuberenlosis associated with fever

Hemophilia and hemoptisis

Valvular heart lesions of any marked degree

Marked general nersous condition

Albuminuma to any considerable amount

Skins extremely sensitive to light above a solar eczema or Hutchin son's prurigo

#### RADIANT LIGHT

Definition —Radiant hat consists largely of the luminous rays from the care, carbon tungsten or nitrogen filment lump. This light is generated by the electric current, contains some of the intra red rays and all of the wavelengths of the spectrum. Since the filment lumps are always enclosed in glass bulbs we may assume that no ultraviolet rays pass through the glass and rach the patient. The color of the glass has probably but slight influence upon the therspecture effect of the light. The rays transmitted through red glass are alightly more irritating and burning while those through blue glass are less irritating and slightly analgene. This selective effect of color, however is greatly evaggerated in the claims made for certain lamps.

mountain air It should be constantly kept in mind that the shorter rays will not penetrate glass or the thinnest cotton or silk cloth

Physiological Effects - As would be expected, physiologic I effects vary somewhat with the varying ultraviolet content in the sunlight. The local effect upon the skin varies with the dosage. Laroquete has clearly described the effect of the solur rays on the skin as follows When the exposure is mild in type and of short duration, there is produced a mill erythema which disappears after the exposure If the duration is suffi cient, this primary erithemy remains and is due to the effect of the heat rays, similar in effect to those from hot air or other thermal sources In longer and stronger exposures the epidermis is affected by the light rays, especially by the more rapidly vibrating ultraviolet band, producing slight capillary extravasation of blood under the skin and followed by pigmentation, varying with the intensity of the exposure exposure results in a real dermatitis of painful type with exidation and Prolonged exposure Lives a typical first degree burn with necrosis of the epithelium, connection and dilatation of the blood vessels, hemolysis, edemy and extravasation of blood pigment into the tissues Repetted exposures of moderate duration, superimposing one burn on an other may produce an accumulative burn of considerable severity or the skin may become pigmented and immune from further burning. The general systemic effects of properly grided doses are, as a rule, an increasing hemoglobin percentage. The erithrocytes often show a steady in crease An immediate lenkoponia is followed by a lenkocytosis and gradual return to normal There is a general increase in all the assimila tive and eliminative processes of the body. Some of this general tonic effect must, undoubtedly, be attributed to the associated fresh air which patients under this type of treatment receive

Technic -- With properly constructed aind breaks, patients may be treated through a large part of the year even in a chimate as severe as New England, providing they become hardened to it during the milder months Special caution to prevent chilling is necessary at first. The head should be protected by a small screen. The treatments, to be ef heacious, require that practically the entire body be exposed to the direct rays of the sun Leonard Woolsev Bucon, in his treatment of tuberculous ex service men, has devised an inexpensive arrangement easily built on any hospital roof or porch It consists of two long cross beams notched in pairs throughout their entire length to hold the handles of the ordinary arms litter with a circular head screen of wire covered with ordinary muslin which fits into the bead beam. The portability compactne s and cheapness of such an arrangement should allow for the treatment of many nationts at the same time, with the expenditure of very little money or effort The mitral exposure and amount of daily increment must depend upon the patient's tolerance to the sun The dark complexioned tand

rays, ultraviolet light as before stated not being present. Spasticity of superficial muscles may be greatly reheved.

General Effects—These are due to the Interation of best and mild stimulation of the sympathetic nervous system increasing slightly all the metabolic processes of the body. The rehef of deep-seated pain has been repeatedly demonstrated chineally, but a satisfactory sementific explanation of it has yet to be evolved. The claums made for the effect of lumi nous rays upon the blood count are varied and for the present must be discounfed.

Apparatus — A wide variety of radiant halt apparatus is at present on the market varying from small portable 100-candle power lamps with

reflectors to 2,000-candle power lamps on adjustable stands. For home use the smaller lamps are quite efficient but for extensive clinic hospital or office practice the larger lamps are to be preferred There are also available a num ber of types of apparatus containing from two to sixteen small carbon bulb adjustable in various ways, to place over a certain part of the body Some of them are well built with switches con trolling a given num! er of lights but they have been largely superseded by the use of the more powerful single bulbs It 14 important that the 1eflector should be o arranged that the light will be properly focused on the patient's skin a given distance from the lamp usually twelve to eighteen inches If this focal distance is maintained there is economy in the use of the lamp For general body treatment a large variety of bath cabinets have been man



FIG 2 — THE 1 500 CANDLE POWER RADIANT LAMP WITH STAND

ufactured both with and without reflectors and ventilation. The number of lights in these cabinets varies from forty to one hundred. The reflectors used should be so arranged that the rays do not overlap. There is probably no particular advantage in having such a cobinet ventilated during treatment. Those cabinets in which the patient is placed in a horizontal position are to be preferred to other types.

Carbon Arc Light —This type of light is not glass covered and con tains a certain proportion of ultraviolet rays. It has been developed by Finsen in the Copenhagen Institute Fixme particles of carbon prevent the treatment of patients directly, under the light. Four telescopic tubes Therapeutic Effect —There can be no question of the fact that lumi nous rays penetrate to a depth of nearly one and one-half inches through



Fig 1-Bony Radiant Light Bath Carlnet

ordinary ti sue and some writers claim far greater penetrative power Umost all of the radiant energy is undoubtedly changed to heat in the tissue . and this heat is liberated as deeply as the rays pene-Turrell tates trate that in clinical practice he detects little or no difference between the effects of radiant heat administered by light baths and the effect of the convective heat of the hot air bath, or con ducted heat by means of the direct application of other substances to the skin He states that the convenience of the electric light as a mode of application is all that it has to commend at above

is doubtful whether any other form of het except diathermy penetrate actively vir culir trisue to the depth of rudiant light. The qualitative effect of light upon the skin and senory nerve endings is probably definite and greater in the case of the radiant energies. Other writers, notably Kinney and Snow, state that the effects produced upon metabolism cannot be explained on the hasis of the het production alone.

Local Effects —The c are manuly the interest stimulation of the skin and skin glands consequent upon the marked degree of hyperemia in duced in the skin and subcutaneous tissue to the depth of the light punction. The analgesic effect of light is very marked and constitutes one of its main therapeutic indications. This effect too, is produced in proportion to the amount of heat developed. Its bactericidal effect, especially on anaerobes, is great though this effect is less marked than with ultraviolet irradiation. A slight local pigmentation of the skin follows repeated exposure to radiant light and is probably due to the blue and violet.

in saving that, in general, ridiant light is more effective and has none of the disadvantages of many of the forms of external heat application still so commonly used

Contra indications—There are no red contra indications for the u e of radiant light everyt where its prolonged use might delay the application of the properly indicated surgical mideral or other physiotherapeutic measure. For this reason, if for no other it belongs together with all other potent physical graces, in the hands of the physician

# ULTRAVIOLET QUARTZ OR ACTINIC RAYS

Definition —Ultraviolet rays are the invisible light vibrations, between 400 and 100 millimicrons in length

History - In 1892 Arons was able to elee trify mercury vapor and produce a light en tirely lacking in orange and red rays Some years later, Cooper Hewitt perfected such a lamp in a glass vacuum tube Heraeus Lromayer and Nagel schmidt were collective ly responsible for the perfection of the quartz burner and the employ ment of this lamp in therapeuties The per fection of the tungsten mercury burner and im proved methods of fus ing quartz making pos sible applicators with various curves and angles and portable water-cooled lamps, are recent developments of great value



FIG 3 - MERCIET IL AGSTEN AIR COOLED ULTRAVIOLET LAMP WITH PECTIFIER AND LOCAL APPLICATOR

Physics and Physiological Effects—Sunlight contains the longer ultraviolet wave-lengths those down to about 00 millimicrons the thera peutic effect of which has been already considered in connection with are used to convey the light to patients around the lamp. Its effect rather closely recembles that of sumlight. Since the apparatus is expensive and cumbersome, its use is decreasing and no further space will be taken up with the special technic involved. The writings of Mayer, Finsen, Hess and others are recommended to those who desire detailed knowledge re-

garding the use of this type of lump

Technic - The type of lamp selected will naturally depend largely upon the indications presented The 1,500 or 2,000 candle-power am le bulb has several advantages The patient may shift his position, both as regards distance and direction, without the help of the operator No sat isfactory general elimination, however, may be secured with the us of this type. The body cabinet bath alone will do this work properly. The distance should be determined by the skin toler ince to the candle power The time of the treatment depends not only on the indication but upon whether or not other types of heat, such as paraffin bath, surface high frequency or direthermy, are to be used in communition with radiant light. Where the entire heat effect is to be derived from radiant light, from twenty to forty minutes is the rule, otherwise, as short a time as ten minutes may suffice. In the body cabinet bath it is well to keep the head constantly covered in a towel dampened with cold water and to terminate the treatment immediately when there is undue 2150 of temperature or pulse, or soon after profuse perspiration has developed. Twelve to twenty minutes should constitute the average treatment Some mild tonic type of hydrotherapy or a rest period is idvisable before the patient is allowed to go outdoors

Therapeutic Indications - Indiant light is used as a preliminary measure to ma sage and other forms of physiotherapy To relieve pain in a wide variety of conditions it has no equal in efficiency and ea e of application It is to be preferred to the old fashioned poultice or its modern prototype in cases of local infection, preceding incision or the application of ultraviolet or X ray It is used to bring about surface hyperemia for greater systemic effect by absorbed ultraviolet rais, in price tically all general treatments from air cooled quartz lumps. There are a few indications of special value which should be mentioned separately In acutely inflamed joints where other physiotherapeutic measures can not be borne, radiant light may be used for hours for its analgesic effect In congestive pain in the middle ear or sinuses prolonged treatment by light has proved very efficacious. In the relief of erythema solare, from prolonged sun or ultraviolet exposure it has given good results Pain following operative incision may be safely conveniently and to a very large extent relieved, by prolonged and distant radiant light application The general indications for the ise of ridiant light as Liven are so many, it is so easy and convenient to apply and so therapentically effective that it is certain to receive increasing attention and use. I have no hesitation

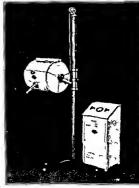
in saying that, in general, radiant light is more effective and has none of the disadvantages of many of the forms of external heat application still so commonly used

Contra indications —There are no red contra indications for the use of ridiant light, except where its prolonged use might delvi the application of the properly indicated surgical medical or other physiotherapeutic measures. For this reason, if for no other it belongs, together with all other potent physical agencies in the handworf the physican.

## ULTRAVIOLET QUARTZ OR ACTINIC RAYS

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recent developments of Fig 3 -MERCURY TUNGSTEY AIR COOLED ULTRAVIOLER

Physics and Physiological Effects —Sunlight contains the longer ultraviolet wave-lengths those down to about 300 millimicrons the thera P utic effect of which has been already considered in connection with heliotherapy The mercury vapor quartz light contains these longer rays and, in addition, is rich in the shorter, more chemically active warelengths, running down to about 190 millimerons. The still shorter arbitration lengths are not vet available for therapeutic purposes. The proportion of ultraviolet rays in the common types of light have been tabulated as follows.

ULTRAVIOLET RAIS IN THE COMMON Types OF LIGHT

Тура	Pr Cent	P Cent Lum u	Pe Cent Lit let
Mercury Vapor	.2	20	78
Sunlight	80	13	7
Carbon Arc Lamps	85	10	5
Incandescent Lamps	93	6	1

Penetration — Ultraviolet rays, even in pure quality from an air cooled lamp, only penetrate a very short distance, because of the red filter screen action of the hemoglobin before mentioned <u>Under con</u> pression from surface quartz applicators or other means, the depth of penetration is very much greater, prohably one-balf to one inch secondag to the completeness with which the tissue is made anemic. It must be recalled that these actinic rays will not pass through glass, paper, thin cloth or ontiment hit will pass quite readily through sterile water.

Variation—There are certain fundamental differences between the quality of lights which emanute from the water-cooled and the incooled burners. The radiations from the air cooled lamp are predominantly the longer ultraviolet wave-lengths. They are more penetrating, are absorbed

in larger amounts and stimulate metabolic processes

From the water cooled burner we get a larger proportion of the short or far ultraviolet wave lengths. It is this band that is most actively germicidal. The penetrative power of these wave-lengths is not as great and they are not as stimulating to metivolism.

With the use of either type of lamp there are certain factors which

cause the expected result to vary

The dust moisture and organic material in the nr, which at times so markedly reduce the ultraviolet content of similght may in like manner effect to some extent the quantity of ultraviolet irradiation the patient receives from the lamps. A more important factor is the variation in and the amount of electrical current. A comparitively slight change in electrical strength may result in rather wide variations in ultraviolet output amounting at times to as much as 15 or 20 per cent

Local Effects—These vary recording to the make and type of lamp used, time, distance, and individual susceptibility of the skin to these rais Ordinarily, no heat is felt and no perspiration induced

The skin may

react all the way from the faintest erythema to a complete first degree burn. The latter is, however, the most severe local effect it is possible to obtain and is insignificant in comparison to overdosage by X ray or radium applications.

In moderately severe doses the following bistological changes in the skin have been found There is dilatation of both the superficial and deep skin capillaries The epidermis may loosen and blister The nuclei of the skin cells show division and the lymph spaces become dilated mild doses there is only a moderate dilatation of the capillaries The erythems does not appear for several hours after the treatment thereby differing from the heat erythems which appears immediately. Pigmenta tion of the skin usually begins on the second or third div is steadily in creased by repeated doses and protects the skin from further exvilema or blistering. The exact effect of the rays on cellular activity is not definitely known The shorter wave-lengths are those which produce most marked changes in cell protoplasm. This is especially true of their effect on microorganisms Bovie found that the parameeium when ex posed to sublethal doses of ultraviolet rays, became so sensitized to beat that they were unable to withstand for a full minute a degree of tempera ture which was optimum for controls. He concluded that death was due to beat coagulation after sensitization by the light Other investigators have found cell protein to be less soluble and more easily precipitated after exposure to light Finsen confirmed the bactericidal action of actinic rass in his work with lupus Bacteria have been killed at a depth of 11/2 millimeters and their virulenec markedly diminished at a depth of 4 millimeters The tubercle bacillus loses its stamin, properties very quickly when exposed to ultraviolet rass and is killed in a short time

The skin dosage is roughly classified as stimulative (mild), regenera

tive (medium) and destructive (severe) erythema

General Effects—It is extremely difficult to give a clear-cut and conservative estimate of the general effects of ultraviolet light upon the body.
We are eager to have our clinical results confined by eart scientific
demonstrations but unfortunately there is not as yet, entire unanimity of
opinion among those who have investigated this subject. It is in gen
eral, found that there is an increase in the percentage of hemoglobin
and in the erythrectic count a temporary drop in the number of white
cells, followed by a fairly permanent increase and a building up of the
resistant forces of the body toward all types of infection. This is the
usual result reported also in the clinical use of general ultraviolet treat
ments

There is often a relief from pain out of proportion to the minuteamount of heat produced and to the possible counterpretant effect of the erethema resulting. This may be due to a selective action on sensory nerve endings. As a rule patients sleep better after properly selected heliotherapy The mercury vapor quartz light contains these longer rays and, in addition, is rich in the shorter, more chemically active wave lengths, running down to about 190 millimicrons The still shorter vibration lengths are not vet available for therapeutic purposes The proportion of ultraviolet rays in the common types of light have been tabu lated as fallows

ULTRAVIOLET RASS IN THE COMMON TYPES OF LIGHT

Type	Pe Ce i	Per Ce t L m n us	Pe Ce 1 Litr vi   1
Mercury Vapor	52	20	99
Sunlight	80	13	7
Carbon Arc Lamps	85	10	5
Incandescent Lamps	91	6	1

Penetration —Ultraviolet rays, even in pure quality from an air cooled lamp, only penetrate a very short distance, because of the red filter sercen action of the hemoglobin before mentioned Under com pression from surface quartz applicators or other means, the depth of penetration is very much greater, probably one-half to one inch according to the completeness with which the tissue is made anemic. It must be recalled that these actime rays will not pass through glass, paper, thin cloth or outment, but will pass quito readily through sterilo water

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With the use of either type of lamp there are certain factors which

cause the expected result to vary

The dust, moisture and organic material in the air, which at times so markedly reduce the ultraviolet content of sunlight may in like manner effect to some extent the quantity of ultraviolet irradiation the patient receives from the lamps A more important factor is the varia tion in and the amount of electrical current. A comparatively slight change in electrical strength may result in rather wide variations in ultra wolet output amounting at times to as much as 15 or 20 per cent

Local Effects -These vary according to the make and type of lamp used, time, distance, and individual susceptibility of the skin to these rays Ordinarily, no heat is felt and no perspiration induced. The skin may dosty. There is used its some tall in a statche blood pressure. The effect of rays absorbed in the blood stream is of course, diffused throughout the body. General metholism and especially elimination cem to be augmented after general treatments. A₀ in let it be understood that while these results are fairly constant and may in the majority of cases be expected under proper technic they are still somewhat empirically employed. The work of \$\cdot \text{P. Here's of \text{Awa Vork Javet II Clark, and others on the subject of irickets has clark dimensionated the effect of ultrivolet hight on blood chemistry. A marked mercase in the morganic phose hours followed by rapid caleficiation of bone was shown after exposure to the ultraviolet hight in a case of irickets in both animals and children. The results obtained by general irradiction in tuberculosis must be of feeted by mans of rives absorbed and distributed by the circulation.

Apparatus—Lamps—We have available are coded lamps for general rations and water-cooled lamps for local work, each provided with rectiners for the alternating current. There are many varieties of stands methods of counterwa, btm, case adjustment and other conveniences for the climitant, but e. Convenience appearance durabulity, power, etc., have

each to be considered in choosing a given type of lamp

Burners.—The larmer is the important part of the lamp Some valuable mormation regirding, hurners has been farmabled by W W Coblents, of the Burean of Standards. There are two types of burners on the American market one consisting of a vacuum are in a fined quartz chamber the are dischirger taking place between electrodes of liquid mercury—the all mercurs burner the other type has metal lead in wires, seekled directly to the quartz burner. Within the burner the enthode is a flat coil of tangsten wire which is at a low red merindescence when the burner is in operation. With tests made at about 200 watts there seemed to be no difference in ultraviolet output either in quantity or quality. It is possible that a difference would have been found with the use of because when the burner with the sugar of the distance, while with the 220 volt current this variation was somewhat greater than the source of the distance, marsely.

The greetest initiasity is received on a surface parallel to the long and of the burner and the oblique rays are noticeably less efficient. Small variations in the light voltage greatly change ultravolet output Burners having A C current operating through rectifiers last longer than those operated on D C Burners deteriornet steadily with use This may be due to the ionized meandees at mercury vapor attacking and combin, with the quartz forming dark deposits which may become porous and admit minute amounts of air which combine with the mercury Purners deteriorate from one buff to one-third after some fifteen hundred to two thousing burners hours.

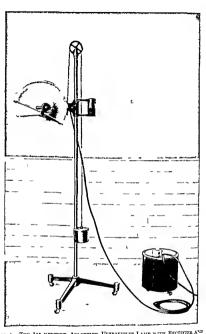


FIG 4 —THE ALL MERCURY AIR COOLED ULTRAVIOLET LAMP WITH RECTIFIER AND COUNTER WEIGHT

castors is more convenient than one counterweighted from the ceiling. The manufacture of burners is a difficult and highly specialized task which makes them rather expensive. They have to be able to withstand a temperature of 3,700° F.

Ipplicators — For general needs one large square applicator, a medium circular and a small circular applicator should suffice for surface work. They are also made curved to different degrees and will conveniently reach all parts of the gums for deatal work. A masal, tonsillar, vagunal and rectal applicator will complete the number absolutely necessary for cavity work. It is desirable in addition to have at least one small sinns applicator. New methods have made it possible to five quartz in such a manner that the rays are emitted in nearly full strength from the end of curved applicators. The rooms in which actume rays are used must be frequently ventilated.

The eyes of both the operator and putent must be protected from the ultraviolet rays, for they tend to set up a compuneitvitis. The manufactures provide glasses which are opaque to actune rays, and they should be constantly worn. A little carelesses in this regard after some familiarity with the larm is common and almost always results seriously

Care of Apparatus - After the rectifier switch is turned on, the lamp is started by tilting the burner so that the mercury flows to the tungsten anode, forming a contact The effect of this contact is temporarily to short-circuit the current and this is the point where the greatest drain on the current supply occurs For this reason every circuit into which the ultraviolet apparatus is to be plugged should be heavily fused at least to 30 amperes. When the lamp is tilted back to its former position, the current continues to pass through the vaporized microury which until thoroughly bested has a high resistance to the current. It will be noted that the voltmeter registers only a small amount of current flowing As the mercury sapor becomes intensively beated, the voltmeter reading increases and the light emitted by the burner becomes more intense. Hence in all types of lamps a preliminary burning time of from five to twelve minutes is necessary before a full quantity of ultraviolet rays are produced and this refers particularly to the shorter and more potent wave lengths The burner should never be touched with the hands but lifted or tilted if necessary by the metal shoulder Clean the burner off daily with alcohol With the use of the water-cooled lump, it must be made certain that a free flow of water is circulating in the lamp before it is turned on If this is not done the burner will be destroyed in a very short time. For this rea on it is safest so to arrange the water intake that either the inflow or the outflow is visible to the operator. It is well also, to allow the water to run for a moment or two after the lamp has been turned off One quick lateral or posterior tilting of the lamp is usually all that is necessary to ignite the mercury after the cur



F10 5 -- STANDARD OF THE WATER COOLED ULTRAVIOLET LAMP WITH RECTIFIES.

the average initial dose, we have three variations of intensity mild, medium and severe. In addition there are three different skin doses, namely, stimulitive, regenerative and destructive any one of which it may be our aim to produce

A stimulative erytheme is the creation of a faint blush after a short treatment at average distance. This produces superficial capillary en gorgement, stimulates surface epithelium and is the degree used for most

general treatments

The regenerative does indices a deeper redness just short of blister ing. It is distructive to surface cells is stimulating to deeper lying cells and produces marked capillary engargement with considerable absorption of rays. This dosage is used in most widespread inflammatory skin discases and for cavity work.

The destructive dose induces blistering and vesseation of superficial layers of cells, entirely destroying them, but the deeper layers of the skin are nurshedly stimulated to multiplaction and grown. It uses in in fective and hypertrophic skin lessons gives us the desired sharp, intense, localized result.

To provide a technic by means of which we may accurately grade the do e in its proper relation to su ceptibility, the minufacturers have provided a method for determining the lamp output. It consists of small pieces of sensitized paper which are exposed for fifteen seconds at a standard distance and developed in water dried and compared to a varying scale of bline, much as hemoglobin is commonly tested on a Tallgrist scale. Opposite each sheet of color the number of seconds required to produce 1 mild crythem a in the normal shin is given.

We then test the putients skin with a dermographic penell to determine its receion. A white his appearing immediately after the servich is normal no result negatire and a red line active. The per on showing a white after line requires the average doe. When no reaction follows increased doesn't required while the red hise indicates a skin which will burn easily. This skin reaction may vary in the same patient at different times.

In the treatment of the average adult patient for general effect an attribute the shell of time and distance for different grades of susceptibility with either type of lamp should prove useful and is appended

All mercury Burner (Initial distance 18 inches)

				-		
Ski R t	f m	D 117 I	m	t	8	đ
Negative	4 minutes	40 30				
lverage	3					
Active	2	l	1!	5		

rent is turned on. Once lighted, it should always be allowed to come up to maximum before starting treatment. During the treatment, the lamp should not be titled to more thru twenty degrees from the vertical plane. This description may, at times, be curried to forty degrees, but it is safer to adjust the patient's position and attempt to maintain the lever degree of titling must mentioned.

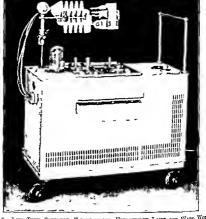


FIG 6-YEW TYPE PORTABLE WATER COOLED ULTRAVIOLET LAMP FOR WARD WORK.

Technic—4ir cooled Lamp—The problem of accurately measured to get a actinotherapy is a complicated one. Slow diminution of effect, due to prolonged usage of the burner, must be convidered. The variation of atmospheric conditions and current strength modify the results obtained Patients differ quite markedly in their skin reaction to the quartit light. There are a few persons, extremely susceptible, who have toward the raws an idiosyncrasy comparable ty that exhibited by some toward certain drugs. These patients develop an intense eczenii which is difficult to allay. Within the range of what might be termed normal reactions to

the average unitial dose we have three variations of intensity mild. medium and sovere. In addition there are three different skin doses namely, stimulative, regenerative and destructive, any one of which it may be our aim to produce

A stimulative erythema is the creation of a faint blush after a short treatment at average distance This produces superficial capillary en gor, ement, stimulates surface epithelium and is the decree used for most general treatments

The regenerative do e induces a deeper redness just short of blister ing It is destructive to surface cells, is stimulating to deeper lying cells and produces marked capillary engorgement with considerable absorption of rays. This dosage is used in most widespread inflammatory skin dis cases and for cavity work

The destructue dose induces blistering and vesication of superficial layers of cells entirely destroying them but the deeper layers of the skin are markedly stimulated to multiplication and growth. Its use in in fective and hypertrophic skin lesions gives us the desired sharp, intense, localized result

To provide a technic by means of which we may accurately grade the dose in its proper relation to susceptibility the munifacturers have pro vided a method for determining the lump output. It consists of small pi ces of sen itized paper which are exposed for fifteen seconds at a standard distance and developed in water, dried and compared to a vary ing scale of blue, much as hemo_lobin is commonly tested on a Tallgrist scale Opposite eich heet of color the number of seconds required to produce a mild erathema in the normal skin is given

We then test the patient's skin with a dermographic pencil to determine its reaction A white line appearing immediately after the scratch is normal no result negative and a red line active. The person showing a white after line requires the average dose. When no reaction follows, increased dosage is required, while the red line indicates a skin which will burn easily This skin reaction may vary in the same patient at different tumes

In the treatment of the average adult patient for general effect, an abbreviated schedule of time and distance for different grades of suscepti bility with either type of lamp should prove useful and is appended

ALL WESTERN BLESSER (Initial distance 18 inches)

Sk R tl	Tm	DlfI	m 1 8	d
regrative	4 minutes	i	40	
Average Active	3 "	!	30	
	2	ı	15	

# TUNGSTEN MERCURY BURNER

Sk n React	T me	D by I m t n Seconds
Negative	11/4 minutes	20
Average	11/4 '	15
Active	50 seconds	10

The different regions of the body vary in their sensitivity to ultraviolet light. The front of the arms burn somewhat less readily than chest and abdomen. The back of the arms and legs require twice the average dose to produce an crythema. The back of the hands withstand several times the usual amount, while the palms and soles of the feet are very difficult to burn.

Age has some relationship to skin sensitivity to the light Infants quite one-fourth, children one third and the aged two thirds of the average unital dose and dark increment

Females react to an exposure some 20 per cent less in time than that required to produce the desired degree of reaction in males. Blond types in both seves are more susceptible than brunettes.

It is not generally necessary to use any intensifying devices Desired intensification may be easily secured by lessening the distance, without the added wear and tear on the burner of the lamp. If an intensifier is used, it should never be applied until after ten or fifteen minutes of burning time.

We have considered so far the problem of initial design. There remains to be discussed the problem of daily increment. This may be seemplished by increasing the time of the exposure, lessening the distance from the hurner to the patient or by a combination of these two methods. Minor increases are better regulated by increasing slowly the time of exposure.

The aim in most general treatments is to produce the mild erythems dose and increase the exposure as rapidly as tanning will permit. We, therefore, divide the body into two or four zones which are rayed successively. In this manner the implicant features of erythema have largely disappeared before that particular surface is again treated, and tanning is slowly developed with a minimum of discomfort or peeling. It is well, even when attempting merely this mild reaction, to explain to the patient that there may occur a real sunburn, because, in spite of all possible precautions, unexpectedly severe reactions occasionally occur and it is safer to have the patient mentally prepared for such an occur rence. In those who burn but do not tan, the dose is naturally much reduced and the daily increase very slight. Where smaller areas than a

full body zone are under treatment, one burn may be superimposed on another with no danger other than the superficial skin destruction already described. The average daily time increase bears of course, a general rabitonship to the time of the initial doos, ranging from 10 to 20 per cent of it. No increase at all may be possible in those who do not tan It should be remembered that a lapse of saveral days during the treat ment especially if accompanied with peeling, will necessitate the return to pretty nearly the initial dose. In any prolonged general treatment it is well to drop back to almost the beguning dose and again work up after a maximum of twenty to thirty minutes exposure has been reached and maintained for a short time. This is comparable to the groung of certain drugs in courses. Various suppleasant seasotions are noted in patients who have been continued at general maximum treatment for a considerable length of time.

In certain conditions noticeably those of or complicated by pulmonary tuberculosis both the zoning and the daily increase must be much more carefully worked out. In some conditions and tuberculous is a notice able example of them, even the average initial doso of ultraviolet light may be followed by a rise in temperature Most of those who have worked with the lamp in these conditions feel that this is not a necessarily dan gerous or unfavorable reaction but comparable to that following tuberculin or the use of certain vaccines However since a temperature ri c of this type is the cause of a perfectly natural alarm on the part of workers not familiar with the use of the lamp and since we must be very guarded in pushing any new treatment especially in active pulmonary cases an effort should be made so carefully and gradually to grade the dosage as to ultimately attrin the desired results without any undue rise of tempera ture Such a plan has been worked out and put in operation in our Service in the United States Veterins Tuberculosis Hospital at New Haven by Major I countd Woolsey Bacon and is described in detail in the section on Applied Physiotherapy relating to Tuberculosis.

Water cooled I amp—This is used only on small areas for very in tensive effect. It is the bactericidal effect of the short wave-lengths that issually recommends its use. For regenerative effect treatment may be given through the quartz window at a distance of one or two mehes from the skin, using exposures virving from thirty seconds to two immites. For most surface work the quartz applicators mentioned are used. They should be carefully cleaned with alcolol before and after each treatment. All crusts, seebs, outments and other foreign substances should be removed from the affected area before commencing treatment. Gentle firm pressure is used directed at right angles to the surface. The surrounding area of skin may be protected by zune ovide plaster, outment towels or beasty black photographic paper. The time of exposure virues from

thirty seconds to twenty or thirty minutes, depending upon the effect that it is desired to produce. In cavity work with the various special splicators, one to two minutes is generally employed. Gentle, firm compression is also used on the guins, and one or two minutes with slight daily increase is the average time of the treatment.

Pacini gives the exposure time required to kill various bacteria sus

pended in clear sterile water at 200 millimeters as follows

	Se nd req d lo kil
Diplococci	
Gолосоес1	6
Менидососси	6
Staphylococci	
Pyogenes albus	10
Pyogenes aureus	17
Streptococci	
Viridans	14
Hemolyticus	18
Mucosus	>5
Pneumococci	
Group I	95
Group II	90
Group III	9,
Group IV	15
Bacıllı	18
Influenza	10
Diphtheria	10
Tubercle	19 1
Lepra	18
Colon	18
Typhoid	90
Dysentery types	-0

Treatment Precautions—It is well to summarize a few of the importint points demanded by proper technic. Burn the air cooled lamp not less than six minutes before starting treatment. Place the lamp so that the surface to be treated is well centered and parallel to the long axis of the burner. If upplicators are used on the sir-cooled light, as occasionally convenient, adjust the patient to the lump and nearly double the time you would use with the water-cooled apparatus. After turning on the rectifier switch, see that the meter needle has moved on to the scale and not below zero. If the latter has occurred, reverse the will plug before turning on the lump. If the lamp has just been used and turned off, allow the burner to cool somewhat before attempting to reliable it, after which it need burn only a moment or two to reach its maximum intensity. With the water cooled lump, be absolutely certain that the water is freely circulating before the lump is turned on and, if possible,

do not tilt it more than twenty degrees during treatment. Tract sunburns similarly to any mild first degree burn with radiant light at a distance

Therapeutic Indications — One hesitates to name all the indications for the use of intraviolet light, lest it be thought that he is advocating a curveall but the judgestions of proceed value are many and judgede

Practically all local skin infections and simple alopecia Sluggishly healing wounds

Burns of all types including those from & ray and radium.

Chronic ulcers of the skin and mucous membrane Sinuses of all types where the area drained has been cleaned un

Deep seated infections, such as ostcomvelitis, tuberculous empyema, adenitis, arthritis, and peritonitis simusitis pyorrhea, alveolar obscess, superficial tonsill ir infection the simple animias and reduced homo-lobin

Pacin, in his text has worked out in detail the hypersensitive skin area occasionally encountered in or, and and functional distributes of the various organs and claims results from re_merative doses of ultra violet light to these areas. The writer would refer those who desire to go more deeply into the possibility of inhibiting reflex pain to Pacini s text

Contraindications —Ultriviolet light is usually contraindicated in patients with extremely sensitive skins, in those with hemophilia and active febrile tuberculosis in the last named at least as regards chest evosure

In the use of all types of phototherapy particularly ultraviolet light both natural and artificial we are employing a method of therapy faith in which is deeply implanted in all conscious living things. Artificial production and refinements in technic have increased its availability and the potency of its application. Its wider use in therapeutics is certain to bring most gratifying results. The caution should be serve kept in mind that necessary surgery or supplementary hygiene and medication should never be postponed or omitted in connection with its employment in therapeutics.

### CHAPTER X

## THERMOTHELAPT

# WILLIAM BENIAM STOR

History—Hear therein or thermotherapy has, from the earliest recovered by a construction of the advisor an included. The old method of practice with the contribution of the above the way of the above horizontal and advisorable and the ast of the above the

The teners we have a new rail at energy and distherms have the last and the rain of the last and there are the with the court of the are the above the last arisen and there are to have true are the many and the court of the many and the true are the last arisen are to have a the last arisen and the court of the last arisen are the last are and the last are the last are and the last are also as the last are and the last are also as the last are also as a last are al

While 4th 4 they was not the tall that radiant energy products to the term radiant held to the control to the term radiant held to the control to the term radiant held to the application of the term radiant held to the application of the term radiant held to the latest to the term radiant held to the following the term radiant held to the latest to the latest term radiant held the lates

If we were rearry be served to be canced by an indestructable, as the life of an indestructable, as the life of a construction in the case of a case of the life of a construction in the case of a case of the life of the li

"When he it was behaved to be a substance the radiation of best made in the manner analogues to the abundanced emission theory," as the actual transfer of the heat fund itself from however radas.

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heat is known to be the energy of heat transferred to the luminferous ether which fills all space and also pervades all bodies. The hot body sets the other particles in vibration and this vibratory motion, in the form of waves, travels in all directions with a velocity of about 186 000 miles per second. If this radiant heat mappings upon a body, port of it may be absorbed or, in other words the molecules of the body may themselves be set in motion by the ether waves. There is no essential difference between radiant heat and light both being forms of radiant energy, the ether waves differing intrinsically, among themselves in wave length only, and thus producing different effects, heating luminous and ehemical, in bodies upon which they impunge, according to the nature of these bodies.

The raye whose heating effects are generally the greatest are of greater wave length thun the e which most affect the eve (light rays) and have longer periods of vibrition. Like light rays, they may be reflected refracted diffracted and polarized. The quantity of heat of a body or the amount of heat energy which a body gains or loses in passing through a given range of temperature is measured in thermal units—heat units—that is hy the quantity of water which it would ruse through one degree Fahrenheit, it is given by the product of its weight into the number expressing the range in temperature are not distinguished. Yet have the continuous sheet of the second length of the

Since heat can be produced it cannot be a substance and since when ever mechanical energy is lost by friction there is a production of heat we conclude that heat is a form of energy"

'In the strictest modern scientific language heat is used to denote something communicable from one body or piece of matter to another'

Light That which makes things visible in physics it is that form of energy which acting upon the organs of sight renders visible the objects from which it proceeds

'The principal phenomena of light are grouped under the following heads (1) Aborption or the transformation of the ubertion of the ether into the molecular vibrations of the body upon which the light falls or through which it passes. The effect of the absorption of part of the light 1373 by a body is to give it color thus grass is green because it sends back to the eye only the rays which together produce the effect of green the other rays being absorbed and a piece of rid glass owes its color to the fact that it transmits only that part of the light whose combined effect upon the eve is that of red.'

Century Dict nary-Heat Century D ctionary-Light.

## FORMS OF HEAT

Three forms of heat, or methods of action of heat, are to be considered as applied to heat theripy—conductive convective and conversive

Conductive Heat—Conductive heat, in living creatures, is the transmission of heat through the tissues of the body, and is limited to the skin, because the circulating blood carries all excess, limiting penetration. All methods his which heated objects are applied directly to the surface or interior of the body are, therefore, very limited in their effects upon the tissues underlying the integraneat

Conductive heat is the least effective method of heat administration, the heat being carried away by conjection whenever applied externally or internally to the skin or mucous surfaces. The parts exposed are promptly rendered hyperemic and the circulating blood conveys the heat on to the general circulation, to be replaced by blood flowing into the dilated blood vessels at the normal body temperature. Thus the excess heat passes on by connection and the tissues beneath the skin remain at about normal rendering of little therapeutic significance applications uch as hot water bottles, poultices, douches, baths, hot packs, wet dressings or electrically heated pads at temperatures that the skin will tolerate toleration to administrations of dry hot air at temperatures of from 400° F to 500° F is possible if the surface is protected by an absorbent, such as Turkish toweling which will absorb the collecting moisture of perspirition otherwise liable to boil and blister the skin. If it were not for this con vection through the medium of the circulating blood, such applications would be impossible and conduction would occur as it does in the roising of a dead animal

That there are undoubted benefits derived from external administrations of heat, even though convection carries away the excess, is conceded, and its therapeutic indications and significance will be considered later.

Convective Heat —Convective heat is conveyed from the surface the rectum, bindder or vagina by the circulatory channels—uterial, venous and lymphate in vill of which the currents are accelerated—to be dispersed throughout the organism and eliminated by the natural channels of dissipation. The writer was the first to recognize the importance of the distinction between the therapeutic effects of external applications of he's and heat derived from radiant sources and believes that the first reference in medical literature so the different effects was nindo in him in 1900. The following very Dr. J. H. Kellogg, of Battle Creek, published a small volume entitled Padiant Light and Heat and Oonicetic Heat

In all methods of heat administration, conductive, convective, or conversive, heat is dispersed by convection, for which reason it is necessary in

the many important therapeutic indications with heat therapy to prolong the administrations as will be shown

Conversive Heat —This is the heat produced in a hody by the transformation of energy, that is by conversion of radiant energy, electrical energy, friction, or any other expenditure of energy, thus inducing the degree of molecular motion or whration in such a body, as respects frequency and amplitude requisite for recognition as heat for heat, as previously shown, is a form of whration in matter. In other words, by the ransformation of different forms of energy—mechanical, electrical, radiant, or themsel—heat is evolved.

The methods of employing or inducing contersite heat which are of importance in therapentics consist in the regulated employment of radiant energy from luminous sources as from the sun from various types of artificial light applicators and from the passage of electrical currents

through the tissues-theimopenetration or disthermy

When radiant energy passes through a transparent medium which offers a minimum of resistance as in case of the sun's rays passing through either, air, or glass little or no heat is evolved. When the radiations impinge upon matter that offers resistance, heat is produced by transformation into heat energy by conversion. The earth a stmosphere is heated by convection from the heated surface of the earth.

Of the sun s rats that pass through the glass window pane, only the ultriviolet are absorbed and those rays are of so great frequency and short wate-length that little or no heat is produced. When light of considerable candle power is passed from within a blue glass bulb it becomes very hot

from absorption of the luminous radiations or frequencies

The absorption of the ultraviolet rays by glass renders heliotherapy by the sun's rays a farce except in the open air Dr. Hess found it necessary to make this observation when considering an erroneous reference to the treatment of rickets through the glass windows of a solarium.

In the work of an emment anthor an illustration appeared showing a patient receiving helotherapy through a closed unidow. This is men tioned to emphasize two facts. (1) that ultraviolet rays do not pass through glass, and (2) that heliotherapy is always presumed to be taken in the open. Furthermore if the house-wife is to derive in her apartment the beneficial steriheaug effects of the ultraviolet rays, the sunlight must enter through the open window.

The penetration of the visible spectrum of radiant energy from lumi nous sources is the same from all sources of white light. The radiation of one candle will be projected as far as that from a source of greater candle power but with an intensity relative to the volume of light passing

The rays of the solar spectrum vary in penetration heat production warmth, wave-length and frequency the penetration increasing with the wave-length from violet to red and diminishing with the frequency from red to violet In other words, "the penetration is as the wavelength and inversely as the frequency" When an electric light is held in the mouth or observed through the hand, the visible rays that appear in greatest abundance are the red

Of the greatest abundance and mereusing wave-length are the in visible infire red rays, which pass to a much greater depth into the uses than the visible rays, and are, therefore, of greater value in point of hest production than the visible spectrum. There is a marked difference in the extent or degree of penetration of the radiations from various artificial sources of light, those, from the electric are and earbon filament mean descent lump being richer in infire red and red rays than those from tungstin lumps. The former also are properly the deeper therapy lumps. There are no deep therapy lamps? except in conformity with the physics of light, though commercial noncuclature. It is sometimes assumed the contrary, thus misleading the numberonce purchasers of apparation.

The demonstrated penetration of the tissues by the radiations of the visible spectrum is about one inch, varying with the density and vascularity of the tissues—fat being least resistant and muscle and box most resistant. Bone is no more resistant than muscle, as it is reddly demonstrated that the visible incudes-cent rays penetrate the antium and sinuses. If so, they also penetrate the instead and to the middle are fact which is furthermore clinically versified. It is plain from the preceding that reflected light is available for producing heat in the tisses to a considerable depth, the energy naturally waning as the radiations proceed.

For therapeutic purposes the radiations should be projected from artificial sources in practically prarilled or slightly divergent beams. Feen of or convergent radiations are too intense to be endured and, therefore, are not practical, and v.t. manufacturers have long persisted in putting on the market lams that always reflect a four

Induction of Conversive Heat —Induction by high frequency electric currents is a subject of profound interest in the light of accumulated thera pentic accomplishments

All electrical currents produce heat as they pass through matter, the and directness of the current or conductivity of the path. He constant (galvanio) current of sufficient writage, that is, volts times the ampere, to produce thermic effects of therapeutic value in the tissues is destructive to the hef of the tissues acted on, and is, therefore, out of consideration as a means of producing heat effects, except for the local destruction of neoplasms. The static sunnsoidal, and induced currents fill other roles in the rapeutics, not excentisly therane.

DArsonval Currents — The e cur ents are variously produced by many types of high frequency apparatus, including open and closed circuit

transformers Pulmhorff coils and static machines in combination with two condensers, a selenoid connecting the condensers and a variable spark gap all in circuit. Types of apparatus for producing these currents now on the market are too numerous to mention.

D Arsonyal's original apparatus consisted of a Ruhmkorff coil, two Levden pars and a coul of several turns connecting the outer coatings of the two pars the inner contings being connected with opposite terminals of the Rubmlarff coul Retucen current terminals connected with the inner coatings of the two condensers-the jars -was an adjustable spark gup that could be lengthened and shortened so varying the resistance in the circuit to vary the downer. The current thus produced when passed from the terminals of the resonator solenoid or coul through connecting cords to electrodes as oscillating or alternating in character at a rate of oscillation giving a frequency of more than 10 000 per second. There are two oscillations in each frequency When the frequencies exceed 10 000 per second muscular responses cease and the only appreciable effect to the senses is heat, if all contacts are closed and no sparking occurs in the circuit except at the spark gap. The only possible accident that can occur is from an excess of heat relative to the size of the electrodes or from circle's removal of an electrode by the nationt when the current is in operation

Nagelschmidt first demonstrated that with a powerful current passing between the two poles, there was no electrolysis—from a K1 solution, nodin was not thrown down Tesla demon trated that with tremendons

potentials there was no danger to life

With the modern types of tran former apparatus provided with multiple spark gips and with means of control provisions crust for scientific methods of producing with safety and practical utility therapeutic adminlatrations of contensite heaf into the deepest recesses of the body

Direct or Bipolar D Arsonval Current—This term was first used by the writer in the second edition of his work High Potential Currents of High and Other Trequences published in 1910 and there described The term is still in common use and interchangeable with those of thermopenetration and dathermy—heating through—applied to this method of heat therapy

The passage of the current through the body was also designated by the author as the direct d Vrsouval method in contradistinction to the indirect method or autoendemstion when the priner is connected to one pole and insulated from the other on the couch. The passage of the high frequency current cyoled by the d Vrsouval method or diathermy heats the trisuis to practically a mufform degree in the path between two chetrodes placed on opposite surfaces if the surfaces of the electrodes are practically parallel so that the margins nowhere approach each other otherwise the current would take the shortest route, following the path of

the least resistance, and the effect would be greater from the contiguous margins

The heating of the tissues is derived in accordance with Joule's law of conservation of energy It is questionable whether all of the heat is produced by the resistance of the tissues to the passage of the current in the fulfillment of that law, or whether the joint action of the rapid oscilla tions at a rate of frequency and amplitude comparable to heat account in part for the heating This latter view is suggested by the conservation of a reasonably small current of very high voltage passing into the resons tor, as compared with the meter readings. In one of his early experiments the writer derived a hot wire meter reading with the d Arsonval arrange ment connected with an 8 plate static machine of 225 milliamperes, whereas the current output of the machine did not exceed 1/4 milhampere, hut was of very high potential Under these conditions it would seem that the conservation may be due in a measure to induced current oscilla tions that represent the amplitude and frequency characteristic of the vibrations of heat A hot wire meter is calibrated with a constant cur rent meter, with the constant current passing through the two meters The meter readings, however, from the passage of the high frequency current through the hot wire meter, do not conform in terms of current strength to the constant current readings, but in terms of heat

That the heat effect is practically uniform between two electrodes of equal size is readily demonstrated by cooking i thick piece of met or a potato hetween two small disc electrodes, when, with sufficient current for the requisite time, it will be found, on cutting through a section, that in either case the cooking process has been practically uniform from

side to side

When applied over the skin, which is more resistant than any other structure in the path, except possibly the outer thin compact structure of bone or of ligament, any temperature that will be tolerated by the skin is ne, lightle as to any danger to the underlying structures

Physics—The physical characteristics and the physiological effects of heat may be considered as depending upon (1) local effects as applied to the surface of the body, whatever the source of the heat, (2) the refer effect derived from the stimulation of the nerve end plutes as affecting the deep centers with the derivation both of local effects and stimulation of the vital processes of respiration and circulation and (3) the thermination of the control of the control

When heat is transformed into any other kind of energy or vice versa the total quantity of energy remains invariable that is to say the quantity of heat which disappears is equivalent to the quantity of the other kind of energy produced and vice versa.

The number of units of mechanical work equivalent to one unit of heat is greatally called the mechanical equivalent of heat or Junie s equivalent and is denoted by the letter J. Its numerical value depends on the units employed for heat and mechanical energy respectively.

effects of the heated blood stream as activating the general functions and activities of the organism

Effect of Local Stimulation - Local stimulation by heat or cold of the peripheral nerves is followed by a prompt reflex response of the vasomotor mechanism, with an increased flow of blood to the tissues stimu lated following the natural law of reflex response to stimulation Hyper emia, promptly induced, is the natural phenomenon for the pre-ervation of the tissues from burning through the application of heat, or freezing through exposure to cold This is observed in the intense redness of the skin when exposed to radiant heat or conductive heat and in the reaction to cold with intense hyperemia. In both cases the natural reflex response serves to maintain the skin at the normal temperature. The influx of blood at normal temperature maintains the temperature of the skin at the temperature of the blood stream as long as the body a reserve is ade quate to meet the requirements In the case of exposure to heat, the latent heat of absorption from the exaporation of perspiration is an added source of protection, also favored by the hyperemia produced as an example of the efficiency of these natural provisions. We have a significant example of this in the therapeutic administration of dry heat at 400° to 500 F when, by means of the ah orption of perspiration by Turkish toweling wrapped about a part the skin is protected from collection of perspiration and from consequent heiting and harming of the surface

The local effects of heat as shown are (1) to induce an active local hypermia, (2) to increase the chimination of mosture through the sweat glands and of schum through the schaecous follules and (3) to expand or relax the tissues, thus relieving skin tension pressure and pain

Reflex Effect on Deep Centers—The reflex effect on the deep spinal centers is one of the most remarkable and beneficial effects of interest heat superficially applied ubon the powers of resistance are lowered or of the stimulating effects of cold to the surface when the resistance is adequate to respond. The response to both heat and cold is the acceleration of the heart's action and respiratory movements to meet the increased demands on the bod's energies. As illustrating the first type of responses I will cite the recovery of a pythent whose condition was critical.

The following observations made by the writer with Drs Grad and Munday would seem to fortify this hypothesis. A patient in extremis from general opticing three weeks after a difficult urgical operation with the characteristic ficeble pulse. In idequal countenance and a temperature with the characteristic ficeble pulse. In idea of 10.0° F, was wripped by the usual method in Turkish towelling and placed in a body hot air apparatus at a temperature of 300 to 350 F and after thirty minutes removed with a full trong pulse a marked byperemia of the skin and mouth temperature of 103° F. Fight hours later the temperature was normal, and the patient was convolescent in ten days. This extraordinary result could only be explained by (1) the

induction of an active phagoevious with a positive chemotaxis, (2) singulation by heat of the deep spinal centers, particularly the cardiac and respiratory, and (3) the elimination of toxins and other bodies thou he the agency of the profuse perspiration induced by the line temperature

Another case reported illustrates remarkably the result of peripheral heat stimulation as follows

"Dr Herman Grid reported a case, that of a child who was brought into the Women's Hospital in a state of collapse. The light bath as described was placed over her body, when a prompt reletion and impresent was set up in her physical condition. The diagnosis of the case was rendered uncertain, the state of collapse forestalling an exploratory operation. It was found that, if the light was continued, she was relived, the low condition returning if it was discontinued. The light administrators were accordingly continued for several days, when unexpectedly the child passed from the rectum several inches of the small intestine. The case had been one of intussusception. The patient made a complete recovers, which would have been impossible except for the employment of radiant light and het during the state of collapse."

These cases are remarkable examples of the profound therapeute effects derived from the administration of heat to the periphers is a means of muntaining or ristoring the utal processes. It is by this principle, as will be shown lotter, that heat contributes to the result of the functions of the heart, as stimulated from the periphers in conditions of failing heart in the asthemic type of fevers, such as pneumonia. For the same reason its administration is contraindicated in decompensated valvular heart leaons.

sated valvular heart lesions

The reflex effect of the cold plunge or shower in the conditions of health is refreshing and, if these measures are systematically used, the vigor of the circulation and peripheral resistance against exposure to cold are increased.

Thermic Effects.—The thermic effect of convective heat, as affecting in the increased heat carried by the heated blood to all parts of the body is to increase the general metabolism of the organism by recelerated circulation of the heated blood with general increase of elimination through the urine and perspiration, with solids in solution. A general condition of well being is also induced due to the increased activity under heat stimulation of the body affinitions, when not continued to a degree of overstimulation which will depress or overfatigue the cells of the body.

Action of Conversive Heat—The action of conversive heat is quite different, applied locally for therapeutic purposes from the action of either connective heat or conductive heat. The object and purpose of administration of radicult light and heat is to produce a local penetrating

effect, with absorption of radiant energy for the relief of local conditions The indication of first importance for its employment is the induction of active local hungrania in the tissues beneath the surface.

#### HYPEREMIA

Hyperemia, induced by radi int energy and high frequency currents, will be found to fill one of the most important fields in physical thera pentics. The three significant effects of hyperciain superficial or deep are (1) increased notition to usesue that are impaired from the pas-size of nutritive pabulum in the blood stream to the parts (2) increased metabolism from the activation of fixed cells under stimulation of the energy applied, and from the effects of the activated blood stream, and (3) increased pha_ocytosis from the greater number of phagocytes con

vesed into the tissues with a probable increase in chemotaxis 1 Increase of Nutrition - The attending increase of matrition is

favored by mercase in both the anabolic and catabolic processes by which waste matters are be tened on from the lamph spaces through the lambhatic channels and by the greater activity of the end or ans in appropriating the nutrition. Elimination promoted by the increased activity of the sweat Llands and increased elimination by the other eminetories is excited by the heat of convection as conveyed throughout the organism Py the administration of conserve heat the hested blood stream conveys exics heat by consection, the equalizing the temperature throughout the body by evaporation and cooling at the surface. There is local in creased circulation in the tis nes throughout the paths of the high frequency current and to the depth that redunt energy penetrates and the fixed tissue cells will be heated by the direct action. By the warming of the tissues and the passing of fluids in the fields so ener-ized the ana bolic processes of nutrition will be accelerated and local tissue building

or repair will be stimulated In the authorized translation of Bier's Hyperemia as a Therapeutic agent published by A Roberts 1900 the subject of hypercinia is treated largely from the point of view of a measure capable of effecting the destruction of bacteria, and acting as a solvent to promote absorption He refers also to its mitrative effects. In this work however, he lays greate t striss upon its effects upon conditions of local stasis although these are better managed by electrostatic modulaties which produce tissue draininge The failure of application of heat to remove infiltrating materials where marked stasis exists has been generally established. By the mechanical effects of the whirlpool bath it is often possible to relieve to a degree the infiltration from swollen stumps, but in general the application of heat for restoring circulation and nutrition, where stall is firmly established must be conceded as ineffective

- 2 Metabolic Effects—The e, as shown, are the effects upon which increased intrition depends and are, therefore, considered conjointh Willy Mever save hyperenue treatment has been found most useful in that it favors the ab orption of evudates and pathological tissue changes of virious kinds. There is no other method that is superior to hyperian treatment in point of genthace and punile success of application, as well as a tendence to rehere prim." The field of indications for the employment of hyperiana for increasing it suc metabolism is one of the kidu indication for the use of thermotherany.
- 3 Effects of, on Infection—Such effects constitute important and extrous for the u c of measures which induce this physiological effect. In the connection it will be observed that these offects are not about due to the mercial duffux of blood with an increase in the number of phagestis in the tissue, but that extrini bacteria, which are susceptible to heat of high are the twood in suft in an effect of conversive heat of great value in the trustment of local infection. The writer has shown in his paramate contributions to this subject that some types of infection, notably the staphylococce a treptococce, and gonococce, are affected locally in the administration of radiant current, due probably to the combined light and heat effects. The ultraviolet raws, while only middly thermic, are the great ultural units plue, acting to do troy all forms of germ life with which they come in contact. It is a baneficent fact that the ultraviolet radiations do troy germ life on the earth's surface and in water expect to the sums rays.
- To acute and subacute infectious conditions alone, or in connection with other measures which inhibit grup processes or increase local hypercurian or both, it (1) increases local hypercurian in the region of infection with a relative increase of leukocytes—the phagocytes, (2) inhibits the activity of the garms through the intensity of the radiant helit and but reductions and (3) simulates the chimination of towe interest, local and diffused by the induction of perspirition and increase in tissue oxidation. By the cinical phagocytesis is stimulated, the germs inhibited and decourted, and the toxic material chiminated.

Derivative Effects—The c are induced when extensive exposures are made rendering the surface hisperenne, through prolonged application of high- null-power include cent lamps over front, buck, and shife, or by the are or meandescent hight buth, and through the coincident profuse preparation induced (1) lessening the quantity of blood in coins stellar goins and the larger arteries and veins, (2) lowering arterial tension, (3) releving an overworked heart, and (4) coincidently promoting extensive elimination of the retuined products of poor metabolism.

There are several possible factors which may be active in effecting

the resolution and healing of septic process es as induced by the administration of hot applications (1) The increased hyperemia occurring with issue ralaxation which is present during the early part of the heat administration, brings into the involved tissues a greater number of leukocytes in proportion as the volume of arterial blood is increased, together with an increased amount of ovegen so essential to local metabolism and prompt diapedesis of the leukocytes (2). The profuse local and agencial perspiration induced alters toward normal the fluids in the field of molvement and conseidently eliminates to an extent other materials affecting the constitutional condition of the patient, possibly fivoring a general plagocytosis (3) The iction of heat upon the superficial tissues may coincidently inhibit the activity of the microbes or, by altering the constitution of the fluids as suggested, produce a larger degree of positive chemotaxis (4) The production of more active metabolism in the tissues will tend, also, to increa o the natural fortifications of the involved tissues, increasing the activity of the macrophinges

Zinsser says of Chemotaxis. The motion of the leukovites toward to making substances indicates a sensibility on the part of the cell to changes in its environment ineited by the foreign a cnt and since the stimuli most likely to reach the leukovites and bring this alteration in the direction of their movements are chemical in nature the phenomenon is spoken of as 'chemotaxis. Since the change of direction brought about in a moving cell by such influences mix be such as either to attract or to repel the term positive chemotaxis is used to designate the former and that of 'negitive chemotaxis the latter. The property of clemotaxis is of vital interest in the present connection since, whatever may be our opinion regarding the relative values of phageovitic process cannot be questioned and any agency which repels the approach of the phageovites must be a detriment, while any factor which attracts them is, of necessity, a powerful means of defense

Willy Mever says. Since it has been demonstrated that, by increasing the inflammatory symptoms a br₀-mung infection can be made to subside we ought more generally to practice abortive treatment of in eigent troubles of this kind for instance of incipient phlegmons or furuncles

While it is not possible to suppress every infection before puts is formed there is no question that he means of artificial hyperenna suppuration can be avoided in a larger percentage of cases than by any of the other therapeutic measures at our disposal

In cases in which suppuration is univoidable even with the aid of artificial hyperemia owing to the intensity of the infection, Bier's treat

ment enables us to accomplish with small incisions what formerly could be achieved with large ones only. This has been shown by manifold practical experiences. The advantage is obviou

'The increased supply of blood listens markedly the course of a suppuration, incomed as it fivers the rapid development of demics to and appration of necrosed portions in soft issues as well as in bones."

Advantages of Hyperemia —The advantages of hyperemia produced by conversive heit or distherms, are mirked as against the Bier method employing of dist heit—the method referred to in the previous quotates by Willy Mever. Penetration deep into the infected art is reheates miny east in which the heited air method will fail, and, furthermore largely limit suppuration meteod of favoring it, as stated by Willy Meyer. This is accomplished by bringing the large number of phagewits into the infected field under conditions of light and heat unfavorable to the bieteris, and so terministics.

From the foregoing physiological effects, and from the effects of heat therapy upon bacteria, we have a foundation upon which the principles of heat therapy are well established

Heat in one form or mother has been it ed in the rapeuties since the earliest times. It is not probable that any measure that gives so much relief from pun as heat could have failed to be recognized by intelligant human beauts.

The sun's rivs, in the form of sun bills, were naturally the fir t source of that employed. It is surprising, however, how little their effects have been understood.

On the field of hittle where the wounded by in the sun's rivs and were relieved from degrees of suffering, it must have been generally appeared to be considered by event for the dieconfort caused by continuous exposure to extransher. It is natural for all forms of life to withdrive from the intense heat of the sun's rivs at middly. Nor his the therapeutic value of riduid light and heat as derived from artificial sources been duly recognized. Its effects are often not appreciated except by those trained in the indications and methods of application. Poulties, hot bitlis, Turkish and his sain biths, mind bitlis, emplishmens, but water bigs, wet die same and hot douches are measures which have been in common use for main generations. These forms of application act upon the surface and are all subject to the principles of convection.

A certain enthisms has been created in the idea that water heated from the earth possessed superior curvative qualities. It is claumed, and correctly, that some such waters contain radium or some other radio extres substance, int, so far as known not in sufficient degrees to product therapeutic results.

The virtue of natural hot baths probably is not so

great as the public is often led to believe for the real virtue of heat need not be sought at fir away points except to indulge the fastidious

taste or for psychological effects Under systematic management, the same physical effects can be derived at any properly managed hydropathic institution sanita rium, or, often even in the home

#### APPARATUS

Ultraviolet Rays—The appropriate enjoyed for the administration of radiant light and hert and the high frequency enreth his keen developed or improved until at the present time the more exact knowledge of their requirements indications and includes of employment cem to have tacked standards approaching perfection.

The introduction by Neils Union of the electric are to the development of ultr violet rays in the treatment of the forms of lipus mixed the carbost type of apprints introduced types now superseded by the air cooled and water cooled nitraviolet limps of the Coper Hewitt mercury varior type.

Hofmann Quartz Carbon Are Lamp (Fig. 1)—A study of the rehunements of the quartz carbon are. I ample introduced by Luni Hofmann Ph.D. Wi reveals that the earbon peneds which burn in a semi-acumin per but an inneise of voltage and decreue of aunterage which results are forced for the penedagon of the penedagon o



FIG 1 -QUARTE CARBOY ARC LAMP (Hofmann)

sult in a 2 inch ere cent unit ually rich in ultraviolet radiations of higher frequency

The radiant energy emerging through the quartz globe includes all wave lengths from the infra red to the ultraviolet of 2,320 Angstrom units (232 millimicrons) inclusive. With the semiquartz globe furnished, the spectrum emitted includes all the wave lengths from the infra red through the entire visible spectrum to the ultraviolet of 2,900 Angstrom units (290 millimicrons) inclusive. As these globes are interchangeable, a convenient means is provided for the selection of ultraviolet wave.

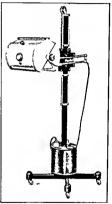


FIG -AIR COOLED MERCLEY VAPOR

or the selection of ultraviolet wavelengths to suit a given condition. At the same time the entire visible spetrum is available and also the infrared.

The quartz carbon are operates on 110 or 220 volts with either alter nating or direct current and uses 10 amortes of current

Uniform quality of radiation is secured by the use of a sensitive electromechanical device which automatically maintains a luminous erescent of constant length

The original carbon are, as used by Finsen, was an open are with a short crescent and poisonous gases produced had to be conducted to the open. This lamp gives an abundance of the shorter irritating ultravolct rays, and at the same time long or midd ultravolct, together with a continuous spectrum, equal to the same and the infra red rays with a middle pleasant thermic radiation. This phenomenon preents excessive burn

Lortet and Genoud later introduced a lamp for the same purpose,

the London Hospital lump which consisted of an are light constructed to reflect its rays through two rock crystal pline len es pliced on either side of a chumber, through which water was flowing to maintain a temperature which would permit pressure aguinst the bare skin without giving discomfort to the patient. In this manner it was possible to ruder the skin anemie and so permit the penetration of the ultravolet rays more deeply into involved wreas. The X-ray latter largely displaced the latter type in the treatment of infections of the skin.

The later invention of the mercury sapor lamp by Cooper Hewitt

of New York, and the adoption of the quartz tube by Dr. Kromaver, of Vienny, introduced an apparatus which permits the passage of the ultra violet rays. These lamps, both air cooled and witer-cooled afford a more potent means of administering the ultraviolet rips with greater numbers of these rays and devoid of the orange red and het rays. The clamps now fill an important place in the thirapeutics of infections and produce other effects upon the blood and metabolism (Figs. 2 and 3)

During the closing years of the numeteenth century, Dr. Margaret Cleaves of New York introduced the use of the marine scarchighd as a therapeutic means of administering radiant energy of high and viving candle power. The radiations reflected from iron-cored carbon cleek trodes are rich in all of the rays of the solar spectrum important in therapeutics. She also introduced the use of the are light but shich

was advocated in the treatment of

inherenlosis.

Minii a Riusian physician who advocated the use of reflected light passed through a natural blue gives bulb or plate for relief from pain introduced about this time the Minii lamp. This form of administration has been variously reputed to passes marked therapeutic an ilgesic effects perhaps largely due to the increa of reflected heat generated in the plass bulb which becomes intened be from the aborption of the other visible and infrared rays. Some au

1 3-(OMEN'ATION AIR COOLED AND WATER (X LED QUARTZ LAMPS FOR ALTERNATING CURRENT

thorities, however still maintain that there is an analgesic effect derived from the blue rays which the author has been mable to confirm

Incandescent Light—Incandescent hi_h-cudle-power lumps were in troduced to the profession in 1904 in the form of the so-called leucodes cent lump. This apparatus was sudely adverted and exploited, which was undoubtedly instrumental in calling attintion to the value of intense reflected incurdescent light radiations.

The idea that candle power contributes to penetration has been largely derived from the introduction of this form of apparatus whereas the caudle power of radiant energy has nothing to do with the penetration but rather with the intensification of the penetration which is limited The radiant energy emerging through the quartz globe includes all well-engths from the infra red to the ultraviolet of 2,920 Angstrom unit (232 millimierous) inclusive. With the senuquartz globe furm hed, the spectrum emitted includes all the wavelengths from the infra ad through the entire visible spectrum to the ultraviolet of 2,900 Angstrom units (290 millimierons) inclusive. As these globes are interchangible, a convenient means is provided for the selection of ultraviolet wave-

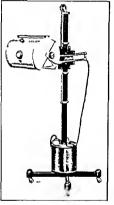


FIG -AIR COOLED MERCURY VAPOR

lengths to suit a given condition. At the same time the entire visible spectrum is available and also the infra red.

The quartz curbon are operates on 110 or 220 volts with either alternating or direct current and u es 10 aumerus of current

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The later invention of the mercury vapor lamp by Cooper Hewitt

of the cabinet bath, so as to carry away the moisture and other emanations and provide a steady influx of fresh air (Fig. 4)



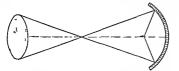
Fig. 5 -- LLUSTRATING THE LAW OF REFLECTIO -- THE ANGLE OF INCIDENCE EQUALS THE AN LE OF 1 EFFECTION

Small Therapeutic Lamps and Applicators —In the writers work Indiant I ight and Heat and Connective Heat and in the first edition



11 6—PETELCTION ROOM A PARABOLA. The loss the relative position of the Laht to the reflect r as if I to ing converg at parallel or divergent rays in conform by with the law of reflection.

of Therapeusis of Internal Diseases he called attention to the importance of reflecting the light rays in parallel or in slightly divergent beams



Fid -Incidence of a focts with the Dark Port Brown the focal loint. A ci cl i dicates the d left at a factor at

(Figs. ) 6 and 7). The incressity for this was suggested by the fact that many lamps on the market reflected a focus at a short di tance from the lamp and so rendered impossible its therapeutic employment unless by the surface toleration of the skin of the patient to the heat. By the use of intense forms of incendescent reduction, from which the ultraviolet ravs are climinated by pressing through glass, the thermse sid luminous effects of radiant energy have been thoroughly investigated and their value as the prescription are supported.

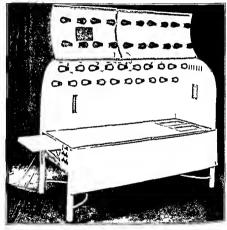


FIG 4-RECLIVING BODY LIGHT BATH

At about the time that the light conditional transfer lumps were exploited.

Dr. Kellogg at the Battle Creek Suntarium introduced the incandes cent light calinet baths and became an irdent advocate of sunlight bibs in the nude state.

Light baths have gone through a period of evolution and change, until now a high state of perfection has been attuned both in point of constinction and efficience. The introduction of ventilation of this form of bath, by the suggestion of Dr Titus, has been recognized as important, in order to allow the escape and change of air during the administration treatment, for, as Dr Byron S Price has well suid, the term baking is not only abourd but wholly misleading Bahn, means cooking and necessitates an elevation of temperature in the interior of the substance that is being biked to a degree of 160° F or higher, whereas the body

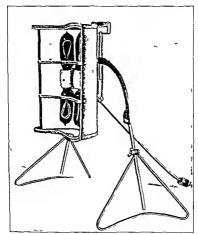


Fig. 10—Smaller Type of Milliple Light I prelected Made Adjustable for Convenience by Transport

temperature general or local probabls never exceeds  $106^{\circ}$  F under the most intensive treatment'

The meandescent light bulbs employed in thes, lamps as in all thera peutic lamps which aim to produce the greatest degree of heat ponetra tion, are of the carbon filament type and as previously stated the o-called deep therapy lamps are only so in name, as penetration depends upon the quitty or relances of the raw in the waver of greater wave-



FIG 8—SHALL HAND LAMF PROJECT ING PARALLEL OR SLIGHTLY DIVER SENT RATS

the manufacture of a type of appa ratus that had been introduced in the Woman a Ho pital in New York City by Dr. Herman Grad The first lights manufactured were employed for warming up the bodies and limbs of the young victims of poliomyeliti, the treatment of whom at the reque t of Dr Pega nald Savre, was placed under the writer a direction in Bellevue Ho nital New York City, following the epidemic of 1912 These lamps of different form (Figs 10 and 11) were extensively employed in the Physiotherapeutic Departments of the Government Hospitals during and following the late War and probably accomplished more toward bringing the profession to the recognition of the value of radiant energy in therapenties than would have been otherwise po sible

An error in the terminology of this form of treatment, "baling" was instituted at this time Ao greater error in terminology could be made than the employment of the term 'baling for this form of

rapidly moved over the surface. A lamp of suitable type has now been perfected (Figs 8 and 9). This en ables the operator to place the lamp in position at a distance at which the temperature can be tolerated for require temperature can be tolerated.

Multiple Light Reflectors—The need in therapeutics for a uniform reflection of light over con identite surface, such as the trunk resulted in

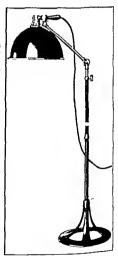


FIG 9-LARGER LAMP OF SAME TYPE AS

treatment, for as Dr Byron S Price has well stud, "the term baking" is not only absurd but wholly musleading.

Baking memis cooking and necessitates an elecation of temperature in the interior of the substance that is being biked to a degree of 160° F or higher, whereas the body

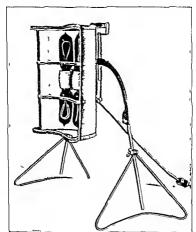


Fig 10 -- Smaller Type of Meltiple Light Replector Mode April Tible for Convenience by Transport

temperature, general or local probably never exceeds 106° F under the most intensive treatment?

The meandescent light bulbs employed in these lamps, as in all therapeutic lamps which aim to produce the greatest degree of heat penetration are of the carbon filament type and as previously stated, the so called "deep therapy lamps" are only so in name, as penetration depends upon the quality or richness of the raws in the waves of greater wavelength and lower frequency, particularly the infra red rays, which are far more abundant as produced from the carbon filament meindescent bulbs



FIG 11 -- LARGER TYPE OF MULTIPLE LIGHT

An adjustable form of in eundescent lamp, reflecting parallel or shelith divergent rays and of moderate cost, is the lamp shown in lags 8 and 9 on page 466

Dry hot air Apparatus—
Dry hot air apparatus is used to administer dry hot air and is constructed for als and electrical fielding, and for himb and body applied tions

Body Type —The lads type of apparatus (Fig. 12) cm be used only by institutions, and is better hented by gis Bunsen burners than by electricity. A

properly constructed apparatus should be provided with menus for opening it and pushing the patient into the opened receptacle or should

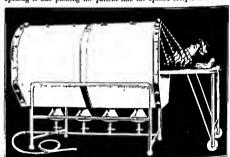


FIG 1 -GAS REATED BODY DRY HOT AIR APPARATUS

open over the rechning table. The heat should be furnished through a bas pipe at least one inch in diameter, in order that it may be possible

to meare adequate pressure to ruse the temperature to 500° F. Turkish toweling wrappings and gowns are a untual parts of the equipment. Experience has shown that there should be an upright shield of wood provided to prevent the outsheating of the patients feet. It is possible that a

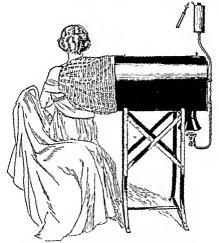


FIG 13 -DRY HOT AIM APPARATES FOR ADMITESTRATION OF HEAT TO LEG OR ARM

body apparatus could be constructed to supply heat by electricity but this is a slower method of getting up the requisite heat, and requires expensive resistance couls for heating in order to supply the requisite .00° P

Extremities Type —For local applicators for the extremities (Fig. 13) the gas apparatus is practical and costs far less than the electrical heating

length and lower frequency, particularly the infra red rays, which are far more abundant as produced from the carbon filament incandescent bulbs



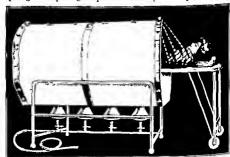
Fig. 11 -- Larger Type of Multiple Light
Resisting

An adjustable form of in candescent lamp, reflecting par allel or slightly divergent rays and of moderate cost, is the lamp shown in Figs 8 and 9 on page 366

Dry hot air Apparatus —
Dry hot air apparatus is used to
administer dry hot air and is
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Body 1 ype —The body type of apparatus (I ig 12) can be u ed only by institutions, and is letter heated by gas Bun en burners than by electricity A

properly constructed apparatus should be provided with means for opening it and pushing the patient into the openied receptacle or should



I IG 12 -- GAS HEATED BODY DRY HOT AIR APPARATES

open over the reclining table. The heat should be furnished through a bas pipe at least one med in diameter, in order that it may be possible

water is thrown into stronger commotion effecting a greater degree of mechanical effect to parts under tratment (Figs. 15 and 16) than the earlier type of apparatus

Apparatus for giving douches and jet sprijs is employed in institutions, its principal effect being to product skin reaction as hot or cold

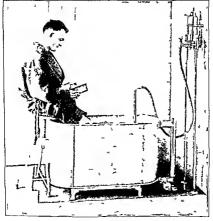


Fig 15-THE WHISLPOOL BATH (Cou te y Dr Bard ell)

jets are applied with pressure to the body. A very active superficial hyperemia of the tissues of the skin is the result but this may often be as well or better obtained by the employment of body administrations of radiant light and heat. In the treatment of the spinal cord or other conditions of the nervous system it cannot be compared in efficiency with the static current.

High frequency Apparatus —The earliest type of high frequency apparatus designed by d Arsonval consisted of a Puhmkorff coil attached

devices and is less expensive to operate. To meet every demand an apparatus open at both ends for applying heat to the knee-joint (Fig 14) has been made by the manufacturers. This apparatus is only of value to those who have not the more effective facilities for treating arthrits by distherms or the state currents.

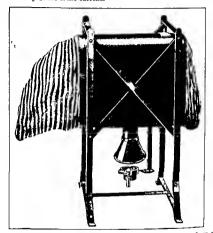


FIG. 14 —THE CAS HEATED DEVINOTAIR APPARATUS FOR TREATING THE KNEE OR ELBOW JOINT

Hydrotherapeutic Apparatus—The freelities for administering whirlpool baths and cold and hot packs are the more practical types of

apparatus required for hydrotherapy administrations

The whirlpool bath, which was designed and perfected in the hos
putals during the Great War, has filled a useful role as a means of producing a peculiar water massage to influend tissues. The value of
this apparatus has been greatly enhunced by Dr Bardwell's design. The
buth should be made of Monell metal which does not require painting
or finishing. This should be made in the original form, whereby the

to a re-onator for trunsforming the high voltage current of the coil to the high frequency current (Fig. 17)

The resonator consisted of two cundinsers either Leyden jirs or other condensers, in which in foil was insulated between layers of insulating maternal A solemoid or col connected the outer coatings of the jars or a corresponding arrangement was made if other types of conden ers were used A spark gip which nuglit be varied in length, single or multiple was placed between connections between the two more coatings. The jars, solenoid and spark gap being, arranged in series with the inner coatings of the condensers were connected with the source of the current on either side A solenoid or ool connected the inner contings (Fig. 18).

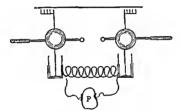


FIG 18-ARRANGEMENT OF COMPS STREE SARE GAP AND SOLENOID. This shows area g ment. Itl put ent in circuit.

The same principle as concerns the resonator is employed with all modern types of apparatus but with greatly improved facilities **Modern Trues = Modern trues of apparatus used for the production

Watern Types—Modern types of apparatus used for the production of high frequency currents emply whe alternating current and consist of high frequency current of a large capacity of immercal trusformer in which the primary and of a large capacity of immercal trusformer in which the primary were received the current from the 1°C or immercal current, or the direct current trusformed to alternating his rotary consister Insulated wire is wound in relativity few turns around the primary, and very fine insulated wire in the accordary is provided with the requisite number of windings or turns and finences to give the necessary indice tames and impediance to produce the desired potential or voltage of the apparatus. The current thus trunsformed we conducted into the resonator. In the construction of these transformers it tention is required by the manifecturies to adjust the unidings and condensers to a true resonuce.

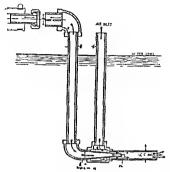


FIG. 16 —ARRANGEMENT FOR I RODUCING THE ACITATION OF THE WATER IN THE WHILL FOOL BUTHS (Courtesy Dr. Bardwell)

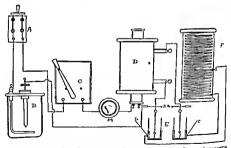


FIG. 1—COMPLETE COLL FQUIPMENT FOR INOU SERQUENCY AND VERY APPARENTS OF THE DARSOVIAL TYPE—A line-world. B interrupter C rhoostet D Ruhmkerf coil E Levden jar contensers I high frequency solenoid GI and G d Arsontal terminals SC high frequency spark and V meter

modern types of apparatus and of an equal capacity in the closed condensers

The Oulin terminal of a resonator is an additional requisite. An attachment to one terminal of the d'Aronval circuit is made consisting of a coil of the Guillimmot type that is, the windings are arranged from the center to the periphery or vice versy, and they are of a sufficient number of turns to give a three to five-nich ducharge from the Oudin terminal. This attrebment is used for administering ducharges of higher voltage than from the d'Arsonval terminals and should be constructed with adjustments to give a range of varying discharges from the cold spark, which will not ignite parchinent paper to a heviter fulguration or burning spark. The latter is applied for administering currents with actium or non-vacuum electrodis and the bot fulguration spark, while the former discharge is used for administering the desociation spark, for the removal of condylomata epithelomas, keratioses and hippis patches

Electrodes for Special Applications—A large variety of electrodes has been designed for special applications now accumen or vacuum of trudes adaptable to the various cavities of the body as well as electrodes for surface treatment. Electrodes for administering diathermy currents are best made of composition metal of a cage that will not crumple, but that will remain relatively smooth—in thickness approximately twenty two B and S aggs. The same material is used for other electrodes. These are made in different shapes usually rectangular with rounded corners and are adapted for applications to virging surfaces and conditions. The edge is rolled up or evenly rounded so that there will be no discharge of fine sparks or sprays from rough edges or angles which would give annoy asce to the patient and misk the administration impossible. These include the more practical types of metal surface electrodes, which can be prepared and used in individual cases as required by the operator.

Disc electrodes provided with handles are furnished by manufacturers, but these are not readily applicable for it is not convenient for the patient or operator to hold them in place during the long applications which are

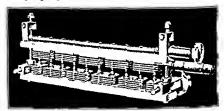
necessary for the rehef required

The clyw and cords for transference of the current and holding the electrodes are of importance. The cord's should be made of flexible or braided wire which will not become angulated and break, because a break in the circuit of a cord will give a very disagreeable shock to a patient. Each apparatus should also be provided with one or two biturcated cords for two strachments to the patients ead so that two electrodes can be connected from one side of the d Arrowald circuit in administering applications to two surfaces from one pole with a large indifferent electrode placed at a definite place to complete the circuit from these surfaces

The clips attached to the end of the connecting cords should be provided with slots, into which may be slipped the edge of the electrodes

for a correct attunement is escential to the delivery of a proper them peutic current

The spark gap of the resonator is one of the most important es estals to a perfectly working apportung. The multiple spark gap should be provided with a number of discharging points and a dister by which the length of these type may be sarred, increasing or dimmissing the restance in the patient's insure (Fig. 19) to the requirements of the heat desired and indicated by a hot wire inster in a ries. The best type of interrupters are those in which the multiple gaps are all opened to gather, instead of increasing, the number or length of the gap. The type of such interrupt is should be made of tangsten a metal capable of with stituding long, usage.



FR. 1) -- Vincen Type of Viltifle Spark Cap Internorme Regulated by Incels incident Spark Fenomerity all of the Caps Constantly by Christian

If they gaps discharge in the open by a method which opens all the gaps it on time the oscillations will be more perfect and uniform that by other methods. Furthermore the wear upon all the typs is the same, and the viritions regulated by opening or closing all the gap is uniform in improvement over mone types of appreciates.

Cros sparkings in the spark gap produce a noisy unharmonious dis charge and a lewer tre means in point of the o cillations than the gaps described

The objections to a closed gap are (1) that it must be frequently opened and cleaned otherwas the discharge soon becomes imperfect, and (2) those with mice availating discrete become punctured, requires that they be replaced

The capacity of the condensers in the alternating current circuit is varied to gue the desired amplitude and frequency. Two to four condunsers of one quart capacity, coated, if Levden jars within and without over about two thirds of the curfact, is the usual arrangement in the

electrodes and efflues, as measures for inducing that locally, are limited by the surface irritation produced. The counterirritant action of the current by these methods induces a very active superficial hyperennia, and the effects are like those of conversive heat, the current passing in and out of the body—at canacture.

The technic of the methods for producing conversive heat radiant light and heat and disthermy is distinctly variable according to the effects sought

Skin Toleration.—In all methods of beat application, there are practical rules of limitation to the degree of heat applied that will vary maternally with different methods. The skin will stand a greater degree of heat from dry hot air than from any other method of application, and praffin haths are tolerated at a temperature far greater than warm water. The surface is peculiarly sensitive to most applications or applications that produce monsture that cannot be promptly absorbed or evaporated

Time of Application—With all methods the indication is to alter local conditions requiring as a rulo prolonged applications of conversive heat in order that the fixed cells may become well heated, that the cooling influence of the blood stream at normal temperature may not to rapidly restore to normal the heated tissues and limit the duration of the hyper tims, which, for beneficial effects, should persist for a considerable time after the administration.

## TECHNIC OF RADIANT LIGHT AND HEAT APPLICATIONS

Position—The position of the patient should, as a rule be reclining and comfortable and the source of the rays should be so placed that the radiations will be projected perpendicularly upon the surface requiring treatment.

Distance—The distance from the reflecting source of light should be adjusted to the comfort of the patient with a degree of heat always verging on discomfort—very warm.

Extent of Exposure—The extent of exposure, as previously stated should be decidedly larger than the ara of moviement but should be so limited as not to cause discomfort from relatively hesting unnecessarily pits not requiring it. This may usually be regulated by the use of a small light appretius for a small area and larger lamps or applicators over the body and extensive surface regions.

Length of Exposure—The time required should be in nearly all conditions, when not otherwise pecified, at least one hour for each administration. In cases of severe conditions as of ergyst glass or absesses the one-hour exposures should be frequently repeated or continuous and continued until severe symptoms have subsadies.

One extremity should consist of an open jaw provided with a scree for elamping it to the electrode. The clips should be capable of being securely held to the electrode, so that it will not become displaced during the process of treatment, when it might severely burn the patient.

Another measure to be provided is a meins for securing the electrods in position, so that a resiless or nervous patient cannot remove them

Another measure to be provided as a means for securing the electrods in position, so that a restless or nervous patient cannot remote their during the passage of the current, and so occasion a disagreeable burn from a small contect during the treatment by an attempt to remote the electrodo when a currant is passing. Pads with strips and buckles or bindrages, which can be secured by the operator, are suitable devices for securing the electrodes in position. Such as a practical precaution aguist accidents in ease of such patients.

Autocondensation—The aniocondensation couch or clear is one of the perquestes of therms treatment. The couch or clear (Fig. %) should be of such length that the patient's body and extremites can be placed in a field opposed to a sheet of metal or wire mesh messuring approximately stateen inches in width by sixty inches in length and provided with a socket for connecting one pole of the d-Vrsonial terminal to the sheet of metal. Over this should be placed a falt or silk has cushion, approximately three inches in thickness and six inches wider and longer than the sheet of metal. The enshion may be covered with leather, cloth material, or partissofe. Upon this the patient should reached the sixty of the sheet of metal and in may be covered with max be employed either for administering the treatment for hypercasson, or in the indirect d-Arsonial method of treatment for heat therapy to be described.

A large coloned for autoconduction treatment, as devised by d Aron val, should be approximately two and one-half to three feet in diameter and six feet in height when extended, and consists of a spiral coil of win, the opposite extramities of which are connected to the opposite terminals of the d Aronval solenoid. This apparities is not often used in this country and would be rirely called for, because the autocondensation method is far more practical and accomplishes all or more than could be accomplished by the large solenoid.

## GENERAL PRINCIPLES OF TECHNIC IN THERMOTHERAPY

Certain general principles apply to all methods of employing heat in therapeutics (1) the surface trusted should always be considerably larger than the parts involved in the pathological process, (2) when sives is established, heat may mercase it whereas before striss is established, heat throughly applied—perforably by the conversion methods—may prevent it, (3) the effects of the high frequency vacuum and non vacuum

weak, irregular or thready pulse Preexisting eyanosis gradually

disappears

In from ten to thirty minutes after the beginning of treatment, and dependent chiefly upon his reflexes the patient a pulse becomes softer, when previously hard Rather quickly there is established a distinct sen sation of a full, soft, rolling pulse often with prolonged diastolic and full systolic periods apparently in part due to the diversion of the blood to the arterioles, whose elasticity is increased by the beat but also to neuromuscular stimulation. The quality of the pulse is characteristic once one is familiar with it.

"If, however, the body has been exposed to a temperature much lower than 400° F no such effect occurs but after a considerable length of time, there is, instead of stimulation an actual depression, accompanied by mental mactivity and a general sense of laxity proportionate to the length of time the patient is exposed to the heat. Such effect from alox and low heat application neutralizes all attempts at producing reflex stimu

lation, later by rapid and high temperature applications

Under these latter apcorrect conditions a patient suffering from car diao dilatation or toxicity shows little tendency towards improvement in the quality of pulse at any time and if lon, continued there is still further evidence of depression and increasing (vanosis?

In order to note the heat effect produced upon the deep glandular areas Dr Price has found that it was necessary to continue the heat application until the peak of nervous stimulation has been passed with a tendency to drowsiness el e the natient is left in an uncomfortably over stimulated pervous state without the full accomplishment of the main object glandular stimulation. This period also corresponds with that of the fully developed and characteristic pul o quality

'The patient's temperature is no index to sufficient dosage, and, if it were an accurate reading could not be obtained by mouth because of the cold applications Even the rectal temperature does not increase much over 2 F under usual conditions Therefore the result obtained is impossible of explanation from the penetration of heat. It is a reflex result

During this time the patient is always kept incased in Turkish towel ing and cold applications applied locally to the head. The room should he kept at a temperature not lower than 75° F for a period of five to fifteen minutes during which time the water temperature is lowered somewhat.

'Immediately upon the establishment of a complete reaction the patient should be transferred from the oven table to the lowering device which is in readiness over the bathtub full of water beside the oven table This water must be at a temperature of from 107° F to 109° F, depend ing upon the patient.

Large Applicators—Large applicators with multiple lights within a reflecting surface are used for their tonic and constitutional effects, and the treatment should not be continued until they cause a feeling of exhaustion One-half hour applications are as a rule, sufficient.

Light Baths—These hiths should be administered, except in study individuals, with the patient in a reclining position and followed by a considerable period of rest after the administration. The temperature of the lath should be such as not to cause discomfort to the patient and the time ordinarily not longer than twenty minutes.

#### TECHNIC OF THE OVEN BATH

No treatment should be administered during the period of active digestion or while under exertement. The room in which the treatment is given should be well ventilated and should be at a comfortable temperature at the time when the patient is being transferred, when all draughts must be voided

The administration should take place with the patient lying in position upon the oven table. The oven table should be perforated and provided with a mattress about one unch in thickness for the comfort of the patient, and to protect against hurning. The pitient should be covered with three thicknesses of Turkish toweling tucked in around the extremities or angular parts of the body. Additional thicknesses of toweling should be supplied over the feet and legs, and, if the patient is corpulent, another thickness over the abdome. These wrappings should be without folds and applied without undie pressure anywhere, and the lattle should he tucked in under the mattress edge, otherwise some of the heat will escape. The oven table is then pushed into the oven and the heat retaining curtain is placed around the patient's neck and shoulders, in order that the hot air may not escape. The gas is then lighted and the oven temperature should rise to from 400° to 450° F within four minutes. A lower oven temperature and less covering does not give the same result During the administration and also after being placed in bed, the patient's head must be constantly cooled with frequent local applications of foold damp toths.

When the body is exposed to high temperatures and the head is kept cooled a secondary dilatation of the intracranial vessels will be prevented and the following evidence of the reflex effect will be produced

"Shortly there is a marked reflex stimulation [in every case] This stitu of stimulation is accompanied by mental exhibitation and clarity of thought. The pulse becomes slower, fuller, and relatively strong in cases of cardiac dilatation or toxicity in which there was proviously a rapid, Local Hot are Baths —The local bot are both as indicated for the treat ment of local septe infection in an arm or leg where stass and edema are not too marked or where pus, if present in the subcutaneous tissues has been evacuated. The parts should be wrapped in at least three or four thicknesses of Turkish toweling and placed in a smill oren designed for the purpose, upon the suspension device provided in the apparatus, and with the heat retaining current an existing adjusted so that no heat will escape, the heat is then turned on

## TECHNIC FOR ADMINISTERING HYDROTHERAPY

The technic for idiministering hydrotherapy according to Baruch is as follows

The Wet Pack - Two large woolen blunkets are spread upon a mat tress most appropriately placed (a rubber sheet must intersene to protect it from the moisture) upon a high four legged cot Upon this is spread smoothly a linen sheet, wrung out of water of temperature 60° to 70 F. appropriate to the case the blanket should be long enough to extend a foot or more beyond the patient's extremities. The patient is placed upon the sheet with his irms raised alongside the head. One-third of the sheet is drawn from left to right across the chest. The arms are low ered alongsido the body and the other two-thirds of the sheet are brought across the body, covering both arms but leaving the latter separated from the trunk by the intervening sheet. The lower part of the latter is pressed between the thighs and legs and the lower border tucked under the heels. The upper border of the blanket is now grasped with the right hand, drawn at right angles to the classele downward, the fingers of the left hand are placed about infteen mehes from the clavicle against the border of this tightly drawn portion and beld there while the right hand draws and pu hes the latter across the chest over the clavicle and shoulder beneath which it is tucked. This procedure is similar to reversing a bandage Then on both sides the blanket is brought over the body and tightly tucked under it then drawing with the left hand upon the por tion of the blanket or sheet covering the patient, then with the outstretched fingers of the right hand pushin, the border of the blanket covering the body beneath the latter along the entire length of the body

This procedure is repeated on the other side with the second blanket

The lower ed, e of the blanket is now gathered together and tucked beneath the heels Fverthing depends upon complete exclusion of air from the blanket cover The patient may now be covered with more woolen blankets if necessary If the covering has been skillfully done the patient will resemble a mummy whose head is enveloped in a wet turban. Unless

"After a period of five to fifteen minutes, during which time the water temperature is lowered somewhat, the pulse diminishes slightly in frequency and loses some of the characteristic rolling quality. At this time the patient should be raised out of the water on the time let and, under the Turkish toweling, siven a ripid rub with hot salt all over the body. It is imperative to avoid the contact of air currents, even for an instant, as they cause peripheral arterial contact with corresponding subarchine dilutation."

After the salt rub the patient is again immersed, to wash off the salt and then raised out of the water and covered with a hot dry bath eart, replacing the wet one. The patient must always be kept in the prose position, and is not allowed to sit upright for danger of syncope. The blood at this time has been drawn from the interior to the surface, and it may be said in this connection that the skin will continu two-durfs of the blood of the body, for this reason great care should be taken in all the movements of the patient that he be hifted and maintained in a reclaiming position.

After removal to the table he is thoroughly dried and massged, and is allowed nothing to ent or drink except hot water, if thirsty, for a period of two or three hours or more, depending upon the condition, during which period he is not allowed to change from a horizontal pouton of he might suffer in attack of syncope, from the presence of so much blood at the surface.

"After a period of five to seven hours, except where especially contra indicated, the patient may assume his naula course. It is necessary to remain quiet for this period, as such is required for the natural a decomplete restoration of responsiveness on the part of the heart muscay as well as that of vasomotor control. In persons with cardiova of discusse there is serious danger in getting around earlier. If such a person rises too early after the treatment, there is splineline dilatations to degree depending upon conditions, but in all cases the early assuming of the upright position obviously disturbs the channels of viscular dilation as produced by the heat, with the consequence that the glaudular etitivit already established is terminated.

"After a properly managed oven bath in cases of submetabolism there is found in the following twenty four hour sample of urine a marked increase in the total solds over the preceding sample, whether the deficiency was in ures or chlorids, elimination arising from acidosis, interinal toverna or in the blood retention of sugar. The blood analysis correspondingly shows a duminution in urea chlorids sugar, or acctose bodies. This result is so pronounced that such cases, when apparently hopeless, do revive because of the stimulation of the deep reflexes and the prompt elimination."

The aerator designed by Dr Bardwell differs distinctively in the nozzle, which may be attached to any tank, of which there were and are now many forms employed in the Army Hospitals and in the Veteran's chimes

The apparatus is best made attached to the tank as a permanent fixture with provision for the drain overflow. The Leonard mixing valve and air meter should be directly attached to the tank as any two faucets on a sink.

This apparatus is used very extensively in the Veteran's Bureau Hospitals throughout the country and serves a useful purpose as one of the measures that are employed for relieving some of the less common punful conditions

#### THERAPEUTICS OF HEAT

Heat Therapy—This subject embraces a very extensive field of indications. It fills a very important role in the treatment of a large range of impured conditions of function and inflammation. There is undoubtedly no measure in medical use that so apily or completely fills the useful demand for the treatment of infectious conditions as the methods of employing convictive and conversive heat. Likewise, in the treatment of defective metabolism impaired by inflammation and disturbed functions, these measures are used in conjunction with other physical modalities and accomplish results that are not and cannot be obtained by other measures in medical practice.

The application of radiant light and heat dri hot air, and diathermy to the treatment of local infection as previously stated in explaining the physiological effects of hyperemia acts upon infectious conditions in three distinct waxa.

1 The application of heat and light is priticularly efficacious in destroying certain bacteria in sits. All bacteria in superficial fields sus equibile to light or 106° F of heat may be destroyed by applications of radiant light and heat from meandescent sources. In the administration of reflected neandescent light and heat, the limit of the temperature to be employed will depend upon the skin toleration, and so also in the cavities of the body conditions that are susceptible to heat as the presence of gonococci vield to applications of disthermy

The skin and tissues as previously stated will readily withstand the ultraviolet rays and all breteria located in or immediately beneath the surface are destroyed. This property readers them invaluable in the treatment of a large range of infectious conditions.

2 Another method of effecting the destruction of bacteria is by the institution of active hyperemia through heating of the involved tissues given for insomnin the patient should receive an affusion at 70° F after removal from the wet pack and go into the open air after being dried

"Modification of this procedure consists in half proks, in which smaller of the pack (which should be from one-half to one hour), the exture of the sheet, the temperature of the water and extent of pack, as well as the rectitions, modify the effect materially, as will be seen—If given for insoming, the praticit must remain in the pack, if asleep, rapid but gaitle drying follows, and the pack must be given in the bed?

Dr Baruch further states "The first effect of contact with the cold, damp sheet is an irritation to the cutaneous nerves, and narrowing of the cutaneous vessels, which continues until the individual's power of reaction comes into play This depends, as in all hydriatic procedures, upon the age and condition of the patient, old people and children do not react is readily as adults, and a previous high temperature of the sim furthers ripid reaction when circulation is not very feeble. There bein no mechanical aid given by the attendant, as in the sheet bith, reaction depends entirely upon the vital powers of the patient tinguishes the wet pack completely from all other hydriatic procedures, and demands judicious recognition of the patient a reactive espacity soon as the first "shock" is over, which lasts one to five minutes and some times produces shivering, the peripheral vessels begin to dilate, and the system makes an effort to equalize the temperature between the skin and the sheet When the body temperature is high, as in fevers, there is no chilliness, the cooled blood is driven from the surface to the subjacent structures, but very soon the warm blood from the interior takes its place, and dilatation of the vessels is the result. This continuous interchange of temperature which occurs easily and slowly in patients with normal temperature, gives rise to a vaporization of the sheet which furthers loss of heat from the skin This is increased by non-conductivity of the blanket He soon experiences a mild heating of the body due to the conservative powers of the organism, continuing to create heat to compensate for the threatened or accomplished loss"

The Whirlpool Bath—This bath, introduced during the Great Wer for use in the Army, serves as a valuable means of treating open wounds and inflammatory conditions. It was found particularly valuable in the treatment of tender stumps. The parts should be immersed for a considerable time during each administration.

The discharge of water through a one eighth inch opening under pressure as in the Bardwell type of bath (Figs 15 and 16) draws in the singuring a greater degree of commotion in the tank than did the first apparatus used in the Government Hospitals

shit within the first twenty four hours confirmed long ago in the writer's everience, is the application of the static wave current with a small metal or surface vacuum electrode placed directly over the enlarged hardened timal, which may thus b softened with a complete resolution of the in duration b fore pus. There is no danger in the first twenty four hours, lefore, pus, of extending the infection, but the method is effective in resoluring the process and abstraing the tomolitis.

Felons and Whitlows—When these are treated in the first twenty four hours, they may also be promptly rehered by the static method Long exposure, to radium hight and he is should precede the use of the static current in these cases and also in eaces of tonshits. Otherwise felons and whitlows may be treated with ultraviolet rays and incandescent high residually as outlined in the treatment of bods and fururales

Acute Ottus Media.—Treatment of this diserve by radium hight and heat is one of the classical methods in heat therapy that should be universally adopted, and would be but for the institution manifested by the otologist. In the first erige of an ottus media, if ridiant light and heat is thoroughly applied for rie or two hours to the surface, at a distance at which the pittent will tolerate the heat this procedure will often abort the infection at the onset. This the author his confirmed in two instances on his own person. If, however the condition is not aborted, the relict afforded by the local apphentions of reflected incandescent light and her will in uro the pattent great relief from the intense pum. After the pushas legun to discharge, whether a paraceutesis is done or not if the light applications are persisted in with two one hour apphentions or twice dails on subsequent days for at less one hour each time, the trouble will be cured with the membrane repaired within two weeks, and a chrome dischirers, will not persist.

Other Meriden Cities Media.—This can be relieved by daily one hour applications of reflected radiant unembescent light, as in the acute of a This treatment will successfully cur, most cases in which there is no bone nervosis within three weeks and usually much sooner with a healing of the membrane. This method was introduced by Herbert F. Pitcher M.D., of Havrichil Massychusestts and the writer has observed the results from the method in a large number of cases in none of which it took over three weeks to effect a cur. If this statement is doubted a thorough trail and investigation of the method will be convincing

Mastoditis —Mastoditis would vers ruch occur if ottis media was attended to by the method described. It has often been aborted by the method outlined above as reported by Dr. Pitcher in his original paper and this method should be recommended in early cases, notwithstanding the attitude of the amrats. If pending an operation there was a delay for from ten to fiften hours a more or less persistent application of reflected light over the involved parts has in many cases caused a dis

By this means the phagocytes are drawn in greater numbers into the infected field, raising the local resistance of the tissues and thereby enabling the phagocytes to destroy the bacteria, and the tissues to have off the local invaders. The altered condition of mitrition, furthermore gives added force to the fixed cells, the macrophages, in the lymphate system, whereby resistance is forthfield against infection and the system is enabled to throw off bacterial invaders

3 Another method of effectine 1 local process of infection is by the use of the X ray or radium, whereby the bacteria are sterilized and 8 rendered inert. After a requisite series of short exposures, an active hyperemia is induced, as by the previous method, so carrying away the met bacteria. The success of this method is practically demonstrated in tubercular and progenic processes.

## TREATMENT OF SPECIAL CONDITIONS OF INFECTION

Boils —In boils prolonged applications of radiant light and heat, or prolonged applications of the high frequency current from vacuum or non vacuum electrodes, will often abort the process This is accomplished by the induction of active hyperemia and the action of the heat upon the betterna

Abscesses —Ultraviolet rax have proved very efficacious in curie, incipient abscesses when applied through a quartz applicator with compression of the offending process. That such an application may produce a lilister should not forestull a thorough application to the surface, as thister should not disappears and the germ process as well, when treated before pus. The same measure may be effective in aborting carbuncles in the irist stage before pus is formed. The ultraviolet application should be followed promptly on the following day by the application of inflected incandescent rays with long exposures, which will hasten the healing of the blister and further destroy any remaining local infection.

Another method which has been successful in the treatment of are buncles and crops of boils is the administration of an erythema do a of X rays, followed the next day by a two hour application of reflected radiant incandescent light, and this followed by a thorough application of the high frequency current from vacuum or non vacuum electrodes. There are three factors which enter into this method (1) thorough sterilization—not destruction—of the bacteria by the prolonged application of X rays, (2) active hyperemia induced by the radiant light and heat, which carries in a vast number of phagocytes, and (3) tissue resistance and phagogotiosis which is still further accontinated by the application to the surface of the current with the high frequency electrodes.

Quinsy —This may be relieved by the same methods applied externally over the indurated tonsil Another method of treating suppurative ton

hour is remarkable and the progress to a cure usually complete in a few days

Foreign Bodies — Following removal of a foreign body from the eve the application of reflected light for half an hour will afford prompt relief

from the irritation caused by the presence of the foreign body

Eryspelas — There is nothing during recent years that has given the writer greater satisfaction than his own results and those of others from the use of radiant incandescent light in the treatment of cryspelas. The discovery of its efficacy was made by the writer more than ten years ago when a patient came into the office with a well-developed cryspelas of the face in the first stage. The light was reflected upon the surface for one and one-half hours and the relief was complete, as the condition made no further progress. This led to a question as to the diagnosis, but when light was applied later in a very striking and marked case, the same result was obtained with a complete cure of the condition within two days. It was thus demonstrated that eryspelas can be cured by this method, and this has been repeatedly verified.

Local Septic Infection —Local septic infection or blood poisoning has destroyed the lives of many physicians and surgeons, and frequent reports of fatalities establish the condition as a matter of so great concern that the management of the e cases by heat therapy must be considered at lent, the secue we believe to the members methods of great importance

in an otherwise unfortunate class of conditions

When following an accident or operation the surgeon discovers a point of infection or upon a patient a punful apot appears having the characteristic indication of septic infection, the early application of the ultraviolet rays over the aite followed by a long application of reflected insendescent light and heat will in nearly all instinces abort the trouble. In the absence of a mercury vapor lamp there are few cases that will not vield to prolonged applications of meandescent radiations from the small therapeutic lamp at this early stage. When however, the infection has become seated in the hand or lee, and I-vmplaingitis appears the seriousness of the condition will be confirmed. That there is no difficult in controlling the infection at this stage, either by prolonged applications of radiant light and heat or by the ultravolet rava either in cases of this kind, or in any case in which pins has not accumulated, is an established fact.

In septic cases which have been opened and drained but in which from peripheral indications extension to the truth, is to be appreheaded, the administration of dry hot-ar in the localized oven for treating arms or legs promises prompt relief. With the parts well wrapped in three or four thicknesses of Turkish toweling and enclosed in the oven employing a temperature of from 400 F to 500° F for one hour daily the heat will promptly relieve and cure the conduction in three or four days. This

tinet fall in the leukoeyte count, indicating that operation was unnecessar Numerous cases of mastorditis have already been reported as having been cured by daring men who were willing to take a chance in the face of surgical criticism. There is abundant evidence of the wisdom of six a course We helieve that every effort should be made to bring the otologist to recognize the importance of employing, in the treatment of otitis media, a measure so safe and so certain of success. When this is done, mastorditis will be a rure condition.

Coryza—A simple coryza, affecting the mucous membrane of the nacions of reflected incandescent light, employing the smaller lamp. The applications should be made morning and excining, with the lamp are pended at a distance that can easily be tolerated by the skin, so as not to cause the patient undue discomfort. If desired, a small pledget of most tened cotton may be put over each eye, but there is no harm from the exposure, if the eyes are kept closed during the application. If administered morning and evening rarely more than three or four applications will be required completely to relieve the coryza. The same measure applied to a throat affected with laryngitis will afford relief. The effect, however is not so uniformly successful as with coryza, but promptly yelds.

Sinusitis —When this is treated by the same method as correl it will require a greater number of applications, but in most cases can be conpletely relieved within one month, varying with the condition—acute or chronic. This has been a routine practice in the offices of the writer for the past fifteen years, and the results have been so uniformly successful that he can speak in the highest terms of the results.

Another heneficial method in these cases is the use of diathermy will the active electrodo placed over the forcheid and sinuses and the indifferent one upon the hack of the neck. The active electrode should be about two inches in width and six inches long. The relief from disconfict, is often instantaneous.

Suppurative Conditions—In suppurative conditions of the antium the persistent use of light, after the cavity has been drained through an opening into the naires, can be depended upon to dispel the condition which would, otherwise, be persistent. To relieve this condition either a sumunits or in antiral abscesses will require several weeks of daily use of the radiant incandescent light.

Purulent Conjunctivities—In purulent conjunctivities of programs and gonorrheal origin the radiant meandescent light is remarkably effective in conferring relief. It is, undoubtedly, the heat in these cases that effects the destruction of the bacterial process. From the institution of the treatment applications should be made of one hour in duration each followed by a two hour interval. The relief from pain in the first half

said to the writer that he bad tried the next case, with success, and that he now employs it is a routine method not only in infections, but before and after operations

It will be seen by these reports that, even in serious and neglected cases the measures are successful, so long as a serious destruction of the parts or adhesion of tendons in their sheaths has not yet become assured

There is no subject among those here treated for which the author a ks 1 more conscientions sympathetic investigation of the statements made than in sentic cases since thereby fatalities can be curtailed and the number of disabled and crippled limbs can be reduced

Indurated Acre ... This class of condition as not as a rule successfully

treated by the usual dermatological methods. During the past twenty years very many young men and women have come to the office of the writer and his nife and associate Dr Miry Arnold Snow, with their faces scarred and in varying degrees covered with large heavy some pustules The practice of treating these cases he puncture curettage tud anti cotic injections has been of hittle avail in heu of what we behere to be the curative method of choice—the Ariv. We wish to emphasize here the importance of employing other methods with this

If following the list X ray exposure there are still a few persistent pustules a small number of applications of the vacuum electrode prof crable employing the static current but otherwise with the high frequency apparatus thoroughly applied over the face will leave the skin free and clear of the infection

It may prove possible though in the writer's experience this has not hen demonstrated to cure indurated tone with repeated applications of

the ultraviolet rans The difficulty in furnucles and crops of boils is that the extension of the infection takes place through the lymphatics under the surface of the skin and that the processes crop up like weeds in the garden from a preecdin, infection, which the ultraviolet ray may not punctrate deep enough

to forestall as the X ray does It is probable that persistent applica tions of the glass electrode currents or of reflected incandescent light would be more effective in these er es than the ultraviolet ray The X ray has filled the role in the writer's experience without a failure in a very large number of cases, at least fifty and he cordially endorses the method

In sample acne the chief indication is to produce contraction of the outer layer of the skin and so close the mouths of the sebaceous fallicles against admission of foreign substance and consequent black heads and suppuration It is in the relaxed porous skin of the young man or woman at puberty that this condition generally occurs and the presence of these blemishes is a source of great annoyance to those so marked. One series of Y my exposures will usually suffice to effect a cure. This has been verified in the experience of numerous writers

statement is based upon personal experience with a large number of easis without a futhere

The following case reports will illustrate the method in scroots cases under varying conditions. There are so many failures under the present practice of applying hot wet dressings and the kinfe, and so many of these cases occur, as to lead the writer to urge the investigation of the methods outlined.

Case 1 Mr S referred by a local physician came under ob criator after numerous openings had been made driving the pits from the six entaneous its since of the arm and for irin. The arm was wrapped in Inrkish toweling and placed in the local oven apprixtus (Fig. 1°), a cording to the technic elsewhere described. The treatment was given, is a customary, for from thirty to forty minutes with a temperature of 400° F. After this application the irin was dressed and bindaged, and the treatment was repeated on the following day and aguin on the thrifty of these three administrations there was no further evidence of infection and the parts in field promptly without further treatment.

Case 2 A local physician who had infected his right hand at an operation came with a distinct swelling in the hind and forcarm who evidence of fluctuation or the pre-cince of pips, but with a lymphangita extending up the arm to the availa, indicating that the infection wis will advanced. The part was subjected to the same treatment as the pre-ceding case, and only three treatments were necessary to remove the infection. As a rule this is the ordinary routine before pus 1 formed in the subentracons tissues.

Case 3 The third case is presented a condition that hid been nighed for three months following the infection. When the case came under observation there were three sinuses discharging puts on the bick of the right hand. The joints were stiff and the hand nicles. The end of the index finger was sloughing to the bone. I he examination dema strated that the tendons were not bound in the sheaths. A good pregness was given, much to the surprise of the surgion. We instituted the drivation of the treatment of the times and in the interval long applications of reflected incidence of the times and in the interval long applications of reflected incidence thigh were made, and the forearm and hand were exercised and whrited between treatments. The parts gradually became flexible, the same colosed, and the ulcerations the end of the index finger he had promptly within three weeks. The parties was able to return home with a useful hand.

In an interview with Dr Othsher in Chrego, in the summer of 1911 he related his experience, with an infection in his own arm, from which had been suffering severth when one of the soning into on his stiff suggested radiant meandescent light. As a matter of fact the Doetor dat not have much futth in the mercure, but he said, "Tr a marting." Transiting "Transiting." Stilf skeptical he

said to the writer that he had tried the next case with success and that he now employs it as a routine method not only in infections but before and after operations

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Indurated Acne—This class of condition is not as a rule, successfully treated by the insual dermatological methods. During the past twenty ears very many young men and women have come to the office of the writer and his suffe and associate Dr. Mars Arnold Snow, with their faces carried and in virying degrees covered with large heavy acne pustules. The practice of treating these cares he puncture currettage and antiseptic injections has been of little avail in lieu of what we believe to be the curretty method of choice—the Xivi. We wish to emphasize here the importance of employing other methods with this

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Fungus Infections of Skin and Scalp—In these conditions, incusing times tonsurans, fruus, and syooss, the \$\Delta\$ ray has long held an unque toned reputation as a curative measure. There is, however, no donk that radiant light and heat and the ultraviolet rays, particularly the later, will prove capable of destroying the fungi of these conditions. If the ultraviolet rays are employed, a hister should be induced at each eyesure, and this course should be persisted in. The exposures or applications should be made by passing the rays through a quartz applicator and applying them with pressure over the affected areas.

Urticaria and Hives — These affections usually ari e from a disturbed gastro intestinal tract, often due to idiosyncrasy to some food, and may persist after removal of the cause. They may then be promptly releved by

long exposures to incandescent light radiations

Treatment of Pulmonary Conditions—In the treatment of pulmonary conditions of the treatment of pulmonary conception or successful in limiting the process and relieving the condition than the administration of radiant energy and datherms, particularly the latter. In the inequent stage of pulmonary tuberulous, before there is danger from hemorrhage, hyperemia induced throughout the lung substance by high frequency diathermy offers much through arrestness of the process by the local destruction of bacteria on the part of the lumphoceters. The X ray has been demonstrated to increase local lymphocrosis and is indicated in conjunction with other measures. These measure offer much in relieving the meignent stage of pulmonary tuberculosis, with the corrections of habits, or of digestive disturbance or other functional derangements which have lowered the patient's resistance.

In acute pleursy there is probably no other measure that will give be prompt and complete rehef as diathermy, employing two large metal electrodes, neutily placed laterally on the opposite vades over the large directly opposite. The pain and fever distupers as a rule with the first treatment, which should be applied with as high a temperature as the skin will permit. According to the writer a experience the duration should be for one hour at the first sitting, and the patient should have the vering appared all removed and be either wrapped in a sheet or in a kinome or pajumas. This precention is taken in the treatment of all cases in which the high frequency current is employed over large surfaces in other than the clothing may not become meastened by the general perspiration induced, and so endanger the patient to a future chill from exposure after

Bronchits Acute and Chronic—Acute—Acute bronchitis should be treated in practically the same manner as pleurisy, the electrodes, how ever, being placed anteriorly and posteriorly instead of laterally. The same rules as to desage and precautions against dampines of the clothing and thorough drying of the patient before dressing should be observed.

The electrodes in these cases should be approximately twelve inches square. When there is a complicating laryngitis the anterior electrode may bave attached to it another small electrode placed over the larvix during the administration. There are five cases of acute bronchitis that cannot be effectively cured in two or three such administrations. There is no more gratifying result obtained by any other method in any condition than by diathermy in the treatment of acute bronchitis.

Chronic —In chrome bronchits three or four weeks may be required to effect absolute relief of the condition. Treatments should be given at first daily and continued on alternate days until the chromic cough has completely disappeared. It is rarely necessary in the treatment of these cases to administer expectorants as the relief is so prompt and progressive that these nauseating and depressing measures may be avoided.

Pneumonia —It has been anticipated from the results obtained in the treatment of pleursy and broachites that pneumonia would neturally be rehered and possibly cured by the same measures. Climicians familiar with the indications for the use of radiant light and heat have frequently shown that pneumonia patients are reliced from cardiac weakness with control of temperatures and increased elimination by prolonged applications of this remed: The value of reflected incandescent light in pneumonia has often been confirmed. Even if not employed throughout the whole course, the effects are most gratifying at the time nearing the crass, with indications of cardiac failure and with a weak irregular pulse.

The following case will illustrate the point of view

A physician called the writer in consultation concerning the condition of his father, an aged main who was suffering at the period of crisis with dehrum. The pulse was weak and intermittent and the prognosis serious. Prolonged applications of reflected incandescent light were advised over the chest and body employing a multiple light applicator. The result was highly gratifying. Immediately the force of the pulse increased and the bests became regular the respirations became deeper the defirmul disappeared and the patient made a prompt recovery.

This was in accord with the principles set forth in the previous part of this chapter, where the effect of peripheral heat applications upon the deep spinal in fleves is referred to as affecting cardiac and pulmonary centers.

There is no danger, whatever from such an administration and reflex respinse of the vital centers to peripheral stimulation may be relied upon as other stimulants cannot be with the same confidence

Reported success from the employment of deathermy in all stages of promotions has opened up in a most striking was the indications for its rational employment. It seems from the reports that, at any stage of the infection, improvement is instituted from the first administration. It is possible that when the first severe pleuritic pains and the chill mark the onset if diathermy is at once administered throughout the

involved portion of the lung, the condition may be promptly aborted as occurs in all cases of pleurisy that are treated at the onset. The increase influx of arterial blood to the lungs cirrica along a multitude of please-cetes, which may proce capible of cleaning out the breteria from the lymph spaces, as they do in bronchitis, so aborting the proces at the outset. Cases of severe pleurisy are promptly arrested and we believe that prominonia may be in the first striges.

It is only fair to presume that this would occur after the results obtained in the treatment of advinced cases. Nine cases were uported by Dr. Harry Eaton Stewart of New Hasen Connecticity, which were treated at the Marine Hospital on Staten Island under his direction. In every instance lysis was instituted at the first administration of disthination, the current being employed for not longer than one half hour, and recovery was complete in every one of the cases so treated, except one, a tenth case, in which there were complecting conditions. In this case, the findings at autopsy were "follow preumonia on the left, pleuriss with effusions on the left septeeman in the pleural cavity and an exudate about one-eighth inch thick, which covered the pleura'.

The following are Dr Stewart's conclusions

"The results in these cases are suggestive that diathermy will have a marked influence in bastening recovery in pneumonia In several of the cases the distherms was not is not at all conclusive instituted until the time when in favorable cases the temperature might be expected to start downward, but it is the opinion of the medical state who selected these as test cases that drathermy helped in their recovery When we have had many more cases to report on, we hope to be able to make a more definite statement, but this much we do know, that, with every single case and in almost every single treatment the temporary effect upon the patients was remarkable. Cyanosis disappeared. The expiratory grunt, when present, was markedly lessened or stopped entirely respirations were less labored and the patient received from two to four hours of very marked rehef, in many cases obtaining sound sleep Non diathermy has been ordered as soon as the diagnosis is made in every case of pneumonia at the Marme Hospital"

In the future, treatment of these cases may be administered at the bedside in the hospital or in the patients home by the in tillation of portable apparatus wherever the electric current is found

Numerous manufacturers are making portable high frequency apparatus which can be brought to the bedside when if the current wardinistered by competent physicians who understand the technic, there can be no question as to the expediency of treating or cs of pneumonia in

hospitals with diathermy, as may also be done with cases of pleurisy and bronchitis

Cholecystits—In catarilal cholecystits the administration of diattenderne sover the region, and in acute cases promptly restores the nornal circulation with relief of the process. In chronic cases relief will be relative to conditions. In cholecystits as in all conditions of in fection, the presence of pus contri indicates the use of disthermy

Catarrhal Appendicitis—The sume may be said of the treatment of the cut steps of appendicitis before the development of pair. It is possible in these cases properly to dissipite the local infection relieving the pain and muscular tension by either distinguish or radiant light and heat deferring recourse to surgery.

Dictitians are contending that all of these pending esses may be sived from operation by the institution of a properly constituted diet-one free from excess of animal protein and consisting largely of whole-grain cerells, whole-wheat bread green vegetables, and fruit

The joint employment therefore of the measures referred to will ar rest the process in the early stages and if used conjointly with the estab lishment of a correct dictary may restore the normal condition

Conditions due to the consumption of various stimulants and narcoties as alcolol and opium which impair the secretions and irritate the conditions of various or, and particularly of the stomach liver, and cardia variously disturb metabolism requiring special consideration

The Liver—In cases of acute hepatitis when the leukocyte count will determine that an abscess is not complicating the trouble diathermy passing the current through the liver with one electrode placed well over that organ and the other obliquely on the opposite side of the trunk will arrest an acute condition here as elsewhere. In lieu of diathermy long applications of radiant light and heat for periods of two or more hours as in choice, this will often afford rehef, though not so marked or lengthering high disthermy.

In the atrophic stage of cirrhosis of the liter so called nutting liver' with assitis or in the leter stages with general anasarea diathermy some times accomplishes good results

The following case report will give a clearer understanding of the benefits to be derived from disthermy in this condition

Dr S who had been suffering for several months with general answers with marked sectes eime under the writers observation in this condition. He was able to get around and to come and go from the office but had given up his active work with the Borid of Health and other activities in which he was engraed. Dirithering was administered duly for one hour with one large electrode placed over the liver and the other, of equal size, obliquely on the opposite side of the body. After two

involved portion of the lung, the condition may be promptly aborted, as occurs in all cases of pleursy that are treated at the onset. The increed influx of arterial blood to the lungs carries along a multitude of place-cytes, which may prote capable of eleming out the breteria from the lymph spaces, is that do in bronchitis so aborting the process at the other cases of sever pleuries are promptly arrested and we believe that prelimination may be in the first states.

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(Figs 8 and 9) much rehefe en be obtained. The static wave current would accomplish more in these cases but it the present time it is im possible to employ it at the bedude. In the future, however, hospitals will have these necessary facilities for administering all physical modalities with men trained in their employment.

Body Oven—The body oven in luces three important effects all in dicated in kidney lesions (1) elimination by perspiration (2) drawing the blood into the skin at the surface thus relieving local congestions and (3) stimulating the cardiovascular centers from the periphery and thus increasing the cardiovascular centers from the periphery and thus increasing the cardiovascular observations, therefore will accombials much for the relief of the kidney convestion.

Uremic Conditions—When possible to administer the body hot air treatment employing the method outlined under dry hot air technic it is remarkably effective. Often when a patient is in the state of uremic coms, relief may follow and the patient emerge from the come, and a re-

establishing of the Lidney function may result

Prive Conditions—Pelva conditions, affecting either the male or the female arise from a disturbance of circulation due to infection or other causes. In these conditions conversate heat plays an important role as also does convective heat applied with douches for local applications of heat. These litter have long held a valuable place in the therapeutics of police disturbances.

In infectious conditions of the pelvic organs the use of diathermy applied according to the parts affected using judgment in the placing of the electrodes, promises relief. The other methods of herit application are not so effective, because the heat cannot be applied with sufficient energy and direction to destroy the gonococci which will rarely stand a temperature above 104 F

There have been published cases in which a course of fever lasting for two or three days with a temperature of 104. F. has been followed by the

disappearance of an acute gonorrheal infection

The neutrated use of disthermy and radiant meandescent rays has led to an understanding of the prognoss for the use of heat therapy as stated in the piges on technic. It is possible to administer in the interior cavatics, temperatures as high as 115° F without danger to the tissues as elsewhere stated by making the area of the interior cleek trode one-third the size of the electrodes applied to the surface. With electrodes having these proportions the operator is able to use a temperature of 11. F in the cavities of the body.

Specific Vesiculitis — In the treatment of specific vesiculities by employing electrodes placed against the vesicles and prostate it it is possible to convey the hert through the parts with a temperature theoretically adequate to destroy the bacteria. The apphentions should be made daily for one hour followed by the static wave current to force out the contents

weeks' administration the improvement was marked and the acutes was much diminished, and within three weeks his circumference was reduced from a highly distended abdomen to normal and his general health was so improved that after four weeks he was able to resume his usual routine duties. This was the third cise of atrophic hyer, associated with our rhosis, treated with disthering with correction of acutes to be recorded, the first two having been reported in a paper read before the Greater New York Society hy Dr J H Branth of New York.

It is evident that the hyperemia induced by diatherms relieves the secties. This method is associated with absolutely no danger to the patent, and should be given a routine trial for though the number of ea exported as treated in this manner are few, the result has been a cessation of the section neath case.

Stomach and Duodenum —In atonic conditions of the stomach and duodenum diatherms will play a most important role in increasing the circulation and restoring the normal secretion. Hypochlorhidra is usually associated with a lowered condition of the general system with either anemia or impairment of the conditions and functions of the splanching area. The indications for diatherm or reflected inevndescent light are twofold. (1) to improve the circulation in parts showing impairment of function, and (2) to improve the general condition of the blood and comprove the functions. If a venous stass is present in the splanchine area or in cases in which there is ulceration, in the stomach or diodenum catherms is contra indicated in the first condition until the disparity is corrected and on account of the dauger of henorrhage that might be a caused when ulcers are present. The ultraviolet rats and the X rays offer much for the relief of ulcerated conditions of these parts.

Nephritis—In nephritis the indications depend upon the type of conditions. In chronic nephritis with the presence of albumin and hyaline and granular easts in the urine, as associated with his pertension in progressive arterioselerosis, disthermy offers much for the improvement of the circulators condition. The electrodes should be approximately six by eight inches in dimension and one should be placed over the kidness and the other opposite in front. The current should be administered from one-built to three fourths of an hour duly at first, and less often as could tions improve. This method will accomplish much toward improving the conditions of the kidness.

In acute parenchymatous nephritis it may often be a question as to whether diathermy will be adequate in overcoming the extreme conges ton which may be engorging the ladne; If \(\tau\) marked degree of stans is present, it will not be relieved by heat, which increases, without tending to decrease the engorgement. Upon administrations in the bod over of dry hot air, alternating with prolonged applications at the bedude of reflected incandescent light radiations applied with the canopy lamps

(Figs 8 and 9), much rehef can be obtained. The static wave current would accomplish more in these cases hat at the prevent time it is im possible to employ it at the bedwide. In the future however, hospital will have these necessary facilities for administering all physical modulities with much trained in their employment.

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establishing of the kidney function may result

Pelite Conditions —Pelite conditions affecting either the male or the female arise from a listurbance of circulation due to infection or other causes. In these conditions, conversite heat plays an important role as also does convective heat applied with douches for local applications of heat. These latter have long held a valuable place in the therapeutics of peiro disturbances.

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Specific Vesiculitis —In the treatment of specific vesiculitis by employing electrodes placed against the vesicles and prostate it is possible to convey the heat through the parts with a temperature theoretically adequate to destroy the bacteriar. The applications should be made daily for one hour followed by the stathe wave current, to force out the contents

of the vesicles The conjoint use of the X ray in these cases is undoubtedly an added means of getting rid of the butteria, which with a thorough technic will effect a favorable result

Gonorrheal Arthritis—It has been demonstrated for a long time that gonorrheal arthritis will veld to the combined methods of state and dathermy. The high frequency entrent may be administered either with the vacuum or non vacuum electrodes or metal electrodes against the prostate and vesicles. If the infection is superficial, the high frequence current administered through glass electrodes is effective in the pelve cavities, and this may be applied with the same general rule as to in tensity with the metal electrodes. When the infection is relieved, the arthritis will respond to the nisual arthritis treatment.

The application of heated metals or irrigations which has been various procommended for administration to the prostate gland for treatment of prostrating possesses very httle relative value, owing to the fact that convective heat is not effective in influencing conditions except superficially. The hot water injections are being administered by phi wears who are not familiar with the use of electricity, or the effects of heat variously applied, and so do not understand how superficial, and of how third avail, hot water irrigations are, whereas, dathermy heat may be applied at temperatures that will be more effective, because the hot is produced in the affected part, not around it. When stiers is established in a part, however, disthermy is not so effective in reducing the inflammation is the strue wave current which does offect the removal of the infiltration and exudation.

Dysmenorrhea — The application of diathermy has been repeated by Dr Turrell to possess ment in these cases by passing the current with one electrode placed over the sacrum and the other above the pubsis If diathermy is used, a better method is to place one electrode in the rectum and the other over the pubsis. This method is not so effective as that with the state wave current with metal electrodes placed in the rectum as described under the treatment of prostatus. By this method the infiltration and exudation is removed and the cervical spism reheated.

Subinvolution —In submodution the same is true as in the treat ment of dysmenorrhea. Heat may accomplish some relief, but not nearly so much as the static current applied as stated

Amenorrhea —There is no question as to the indication for diathermy in amenorrhea, pressing the current through the pelvis with one electrodover the sacrum and the other over the line regions. In lieu of diatherms, reducint light and heat may be of great value in the e cases

Uterine Hemorrhage—In cies of uterine hemorrhage, there will be nothing accomplished with the thermie methods, but here the \$\lambda\$ rar and static wave current will meet the indications

Salpingitis -- Treatment should be given usin, the vacuum or non vacuum vagunal electrode in the vaguna with the other electrode placed above the pubis, using diathermy as outlined in the treatment of vesicin litis The same method can be employed in treating early cases of zuigle oza

Ovaritis -This is usually as oursted with some conditions affecting the uterus, and local applications of conversive-heat may give great tem porary relief from pain, but Justing relief should come from the core of the uterine condition. The use of diatherms will do much toward relieving this painful affection but the static wave current is the method of choice applied with the electrode placed against the uterus at the rectal site which will relieve the venous stasis or congestion and give prompt and complete relief in most a issue

Hot laginal douches which have occupied a recognized place for many years, as introduced by Dr Lobert Emmett are of undoubted value in mild pelvic conditions however with convective heat effect only Douches when employed should be given with the patient upon the back with a proper douche pan and the hips elevated It should be administered with a temperature of 108° F to 110° F and for at least one half hour-in order to relieve local congestion Hot douches do not produce so marked an effect as is obtained by conversive heat with diathermy

Non infective Local Conditions -In the treatment of local conditions of non infective origin diathermy plays an important part if applied in

the early stages

Acuretes -This may be relieved within the first twenty four hours and sometimes later by the application of diathermy and radiant light and beat

Sprains -In the sery early treatment of sprains diatherins and radi ant incandescent light may be effective in relieving the local condition, but

not as a rule. Here the static current alone is the indicated method Contumons or Brusses - The same measure as described above will be

found to be effective in relieving these conditions

Fractures -In the treatment of frictures the use of radiant light applications made daily with one of the splints removed so that the light can affect the part will greatly relieve the pain and hasten repair The open treatment and applications of light with extension play an important role in the treatment of Colles fracture. The period of repair may be so shortened that convaluence often occurs in le a than four weeks

I stensure burns -Burns upon the body are very much benefited by the use of reflected a idiant halit and heat. The treatment for the first half hour is very painful and the patient will recoil from it and six that it is making him worse but if persisted in he will later make no further protests. This has been demonstrated in the treatment of chil dren in Pellevue Hospital There was at first some controversy between the staff and aides concerning the use of ridiant energy, but it has finally been established us a routine method and many lives have been saved and sufferers made more confortable by the established application of reflected light followed by soft dressings to protect the parts. The light should be given with prolonged applications twice daily for at least one hour. Bepur is prompt, as the increased circulation in the true skin brings about a very active improvement, healing as a rule without searring

Gangrene—In south gangrene affecting the extremities, it is remark able what relief can be ifferded in many cases by long applications of reflected meand seemt light, persisted in until the parts often hell over

Endarteritis Obliterius.—The pithology of this condition is obscure, but the results from the employment of diathermy and ridient helit side that have been very successful. The administrations of rifleted helit should be given with long exposures with the applications made over bed extremities, including the parts above the knets. When diathermy is employed, the better way is by the method described in the section on Ecclune, immersing the feet in water, resting upon an electrode to occasional finely depth of a salt solution and the other electrode over the section in this way it is possible to pass the current upward through the limb and all of the structures in the path of the current. I their this method must be employed or the centif method by placing electrodes around the ankles and the other over the sectum, using a bifurcitiel cord situación from one side of the d'Arsonval to the two ankle electrodis. This method is contri indirected if the effect is to be gueral.

Frythromelalgia — Some temporary relief can be derived from the application of heat and diathermy in these distressing cases, but in the writer's experience it is impossible to give listing or permanent relief to

these unfortunate sufferers

Myocarditis—The employment of diathermy through the heart for more artists has shown remarl able results as verified by electrocarding rams. The current is applied with one electrode placed over the scapits, posteriorly, and the other electrode over the exidus in front. The electrodes should be about six inches square, and the current used with a moderate degree of heat, not as great as in the treatment of other thoracis conditions. The treatments should be given daily at first for one-half heat, and then on diternate days.

Desiccation or Endothermy —This method for the treatment of local, malignant, and other conditions, as introduced and developed by Dr William L Clark of Philadelphia and later by Dr Wyeth of New York, is of innusual value for the treatment of local affections of the skin, nuceus crytics, tonsils and hemorrhoids

Appiratus, as described cleawhere, inust deliver from the one pak. Oudin terminal, under perfect control what has been described as a cold spark in other words, a fine spark of such quality that when applied to

paper it will perforate the paper without giving any evidence of burning or charring it. In other words it will not ignite burn, or char but perforate the paper. This quality of spark he of small amperage and produces a distinct desiccation or driving removing fluids from the skin, and was so termed by Dr. Clark for that result.

The tissues treated by this method if applied to the extent of produc

ing complete removal of all fluids are practically killed

When this quality of spark is applied over a small keratosis of the skin, the dried tissue may be removed by the curet, leaving a smooth under lying skin

It is employed with a very short spirk to remove keratoses, warts and moles. The application may not affect the cutis vera unless so desired except in its outer laver and from the nature of the effect cau es draing without bleeding. When however it is desired to destroy malig nearly growth of varying thickness or depth, such as epithelomas the current must be applied with sufficient energy to destroy the growth beyond the diseased tissues otherwise there will be a prompt recurrence and a more rapid growth that before

In treating such a condition at is customary to go well around the outside of the malignant tissues at the outset. After distroying a circle be
out the growth including the deeper later of the shin, the growth is
then attacked directly. The operation, except in extensive growths, may
be done under local anesthe as In small superficial areas there is usually
so little pain or disconfort (that an insetthet is not necessary.

The question always arises as to what method to employ in the treat ment of an epitheliona on the surface. With the X ray or radium properly employed it is possible to remove epitheliomas and rodent ulcers with out producing any scarring or evidence of the former presence of the growth. When removed by the desiccation method there may be a slight scarring follow my the recovers:

When an epithelioma is situated where some important structure such as the tear-duct, would be destroyed by the descention method, the X ray is the method of choice for as has been shown, epithelionas have been circle by the application of the Y ray in the timer canthus of the eye involving a tear direct which has been obstructed and was restored after the \( \Delta \) ray had cured the growth showing the remarkable selection of discaved tissues leaving the normal tissues intact. If descention had been employed under these conditions the circle would have been destroyed

The applications with endothermy should be made deep enough to get to the bottom of the involvement. It is customary to put the needle carrying the current in and out of the mass moving it about until the discased tissues are entirely destroyed. If extensive and deep cut away the descented tissues with enried seriors and then apply the current to the deeper structures, insuring the removal of all of the discased cells

It is possible by this thorough method to destroy all of the malignant tiesues to considerable depths, as has been shown by Dr Clark. Thus not only are the soft structures destroyed, but dien ed bone as well. In the case of bone, however, the area trusted will later separate as a sequestrum or may be curretted or the cled away at the time of operation.

This method of treating malignant growths is particularly applicable to the tongue, hips, and fances, us well as to the larrix. In the later event it is necessary to perform a tracheotony and close the larrix so that there can be no escape of time to the lungs. It is remarkable how few cases of epithelioma of the hip or tongue are followed by recurrence of tracted arily, when the growth modics a smill area, and even where considerable tissues have been involved the prognosis is good if properly done. There have been numerous successes in the treatment of maliciant conditions of the tongue and fances, and uniformly of the hip by this method. It is the method of choice in all conditions involving the mouth and fances and now a greater percentage remain cured by this method than by the kinfe, riduum or X ray.

Tonsils—The treatment of tonsils by descention includes local treatment, both for the purpo c of closing the crypts and for removine pricions of the tonsils. At the present time the X-ray treatment seems to have supplanted the descention method of treating tonsil, though the latter is still largely employed by operators who have acquired a killful technic together with the X-ray.

Hemorrhoid. —For the treatment of hemorrhoid, the desiccation preess is particularly advised. When operations have been done by the clamand cautery method there have often been marked strictures in the recumfollowing the operation. When the de iccation method is employed, there is no stricture.

The desection operation consists of applying a clamp to the hemore rhold and then desiccting the pile and sherring off with the set ors the part above the clamp after which the desiccation spark is applied back and forth between the jaws of the clamp and the clamp removed

By the desiccation method the mucous membrane is sciled off, o af fecting it as to leave no structures or danger of secondary hemorrhage

Philebitis—There are few conditions that give greater evidence of the failure of wet dressings and other local applications of heat, than philebitis Many cases of varieous either some under observation that in-lit have been relieved in the acute influentiary stage. During past year many of the e cases have come under the writers observation in the acute stage that have been promptly relieved.

When seen during the acute stage, the prolonged application of redsailight and heat followed by adequate administrations of the static brish discharge will remove the infiltration from the inflamed vein and sufficiently merease the lumen to permit the blood to pass. The application of radiant

light and beat relieves the tension and the static brush discharge applied over the inflamed vein removes the infiltration thus au acute phlebitis is promptly cured in all cases in which the walls bave not become adherent The writer and his associate have accomplished this in all early cases twice in cases involving the great syphenous vein

Varicose Ulcers -These ulcers arising, as they do, from ob truction in the circulation in parts remote from the obstructed vein cause the tissues to be starved or impoverished from lack of blood. To heal the ulcer a return of the circulation is required. This may often be accomplished by long and frequent exposures to reflected meandescent rays but in much less time and with greater certainty by the added use of the static bru h discharge, which, if thoroughly applied will not only remove the thick ened margin of the ulcer but also the edema from the swollen limb, thus causing the blood to flow back to the region of the ulcer The ulcer should be kept well bandsged during the course of the treatment To prevent recurrence the limb must be supported by proper stockings or bandages

#### IMPAIRED METABOLISM

In conditious of impaired metabolism when the functions of the organism are for any reason mactive or relatively so the administration of conversive heat either by the use of radiant light and heat or disthermy is indicated. We often find this condition in patients who are victims of constinution, who are toxic following severe illness or who are in feeble health from various causes

In these conditions the benefits derived from accelerating the gen eral circulation and that of impaired organs and stimulating the deep cardiac and other vital centers are due to stimulation of metabolism Such applications should be given short of producing fatigue and with au in tensity not sufficient to cause the patient any sense of depression

In patients who are gnemic either from bemorrhage or some other form of secondary anemia, first apply radiant light and heat to the extent of inducing an active hyperemia of the skin, and then follow im mediately while the blood is actively circulating at the periphery, by ex posures to the ultraviolet rays The ultraviolet exposures should always be made short of blistering but sufficient to produce an active hyperemia of the skin. These applications are as a rule given ou alternate days and the length of exposure to the ultraviolet rays may in most cases be doubled at each sitting without danger of causing too great reactions

The following case report will illustrate the success of this method, the patient having been given no internal medicine to increase the red cells, but having been treated as above described

Mrs V —June 28, 1922, red cells per c mm, 2,240,000, whits 4,800, hemoglobin, 68 per cent

-July 6, 1923, red cells per c mm, 3,520,000, whites, 5,600, hem-

globin, 68 per cent

—Aug 4, 1922, red cells per c mm, 3,500,000, whites, 5,600, hemoclobin, 70 per cent

### POSTOPERATIVE USE OF RADIANT LIGHT AND HEAT

There is probably no indication for the use of any measure of greater importance than the use of radiant light and heat after operations When the surgeons are brought to appreciate the value of this measure in opera tive cases before and after operations, bearing in mind that the action of radiant light is practically germ destroying in character, even when devoid of the ultraviolet rays, the measure will be used following operations in some cases while the parts are still uncovered Prolonged applications of light over the surface bring an increased blood supply to the treates that have been shocked from trauma at the operation and so hasten the process of repair and relieve the patient from much of the soreness and suffering immediately following operation. For convenience the patient may be removed to another room provided for the purpose where the dresings may afterwards be applied Conversive heat is invaluable, not only as a means of hastening repair, but for the comfort of the patient The only contra indication is the possibility of inducing hemorrhase in tissues not properly sealed off

Following such an application the patient will lapse into a quiet state with prompt relief from much of the pain and tenderness due to operation. Providing the light is not applied directly over the tissues, but over a thin dressing permitting a degree of light and infra red rats to penetrally a great deal of rehef can so be afforded the patient. Only those who have been subjected to painful conditions following an operation and been

thus indulged can appreciate the relief experienced

# THE OPPOSITE EFFECTS OF THE X RAY AND RADIANT LIGHT

The distinctly opposing effects of the X-ray and radiant light cannot be too often stressed, particularly so now that there are so many new new in the X-ray field employing the X-ray in the repetities

The writer discovered, more than sixteen years ago, that it was not expedient to employ the light and the X ray with the object of doing team work, when he found, after the use for one month of the combined method, that cases under treatment were making no progress as they pre-

viously had inder X-ray treatment. The reflected light had been combating the effect of the X-ray to a degree that nullified its action upon the diseased tissues. Further experience has confirmed this discovery and demonstrated that distinctly opposite effects are produced by the two modalities—in inhibitory effect by the X-ray and a stimulating effect by radiant light and heat. This has been further confirmed in the man agement of X-ray dermatists for there is no measure so effective in proventing or relieving this condition as reflected light and heat. It is verieffective both in promptly restoring, and in antierpating an X-ray der mutitis in tissues overexposed. This is one of the important uses of radiant energy and one, which is the last appreciated by the radiologists who reject the other rational methods.

The ultraviolet rays have been demonstrated to be of great value as a prophyladicate to X-rv dermatitis been either do not prentrate the skin Ther may also be employed to protect the skin during courses of X-ray treatment. The ultraviolet rays may also be need in cases of X-ray dermittis before or following the reflected incandescent radiations and as a prophyladicate before X-ray exposures.

Chrome X ray Dermatitis—In caces of this character occurring on physicians and radiographers hands there is nothing that will gave greater rulef than the judicious use of the ultraviolet rays. This is a very importunt observation, and one that should be known because of the benefits

to be derived

Osteomyelitis — During the treatment of post war cases the use of the ultravolet ray and disthermy have been recognized to be of great value in the treatment of osteomyelitis. There are numerous ever reported that have received only the alterwolet treatment, and that have below progress for obvious reasons. As the o rays do not penetrate the deeper tissues the use with distherms is essential. The exposures to the deeper tissues the use with distherms is essential. The exposures to the ultraviolet rays in the treatment of these conditions should be made on alternate days and the application of the ultraviolet rays should then precede the application of distherms because the more anemic the tissues are, the deeper the rays will penetrate

In this chapter the writer has endeavored to establish the principles of action of the physical measures employed, as to their physiological effects upon the living tissues the practical technic of administering the different methods for producing thermic effects upon the tissues, and finally

their application to therapeuties

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### CHAPTER XI

#### HYDROTHERAPY AND BALNEOLOGY

# WILLIAM J M A MALONEY

#### HYDROTHERAPY

History—Man from his advent has daily experienced the beneficent action of water. Instinctively he drain, when thirsty, washed when unclean, and bithed when tired and heated. The knowledge that water is essential to the maintenance of life was among the first of all human equirments. The relation of vegetation to witer and the cleansing action of the rain streams, and seas must have been recognized even by the earliest forms of human intelligence. Primitive man felt the need of water saw its wide domination in the world wondered perbaps at the mysterious forces which dictate its form and motion, and in his dawning imagnation endowed it with preternatural powers.

Symbolism characterizes all primitive mental expression. It was therefore natural that man should use water not merely when ministering to his bodily, claimness but also when striving to convey ideas of moral purification. As late as the beginning of the Christian era we find this application of water even among the cultured Romans. Pontins Phate when he wished to disclaim guilt and responsibility for the Crucifixion, called for water and washed his hands before the comprehending evis of the clamoring, mob.

Analogous use of water entered into spiritual matters. To-day Hin dust still seek grace by bathing in their sacred strains. Mohammedans perform extansive abilitions as an essential preliminary to praver less wash in prescribed fashion at fixed periods in order to cunform to the lew and Christians are sprinkled with, or immureed in water to wash thim from the stain of original sin in the sacraincia of bytism.

This symbolic use naturally led to the inclusion among religious practices of the application of with rin the treatment of mere bodily ulliments. So hydrotheripy developed under secred auspices and the use of water as a healing agent acquired the dignity of a religious ecremony. Waters from sources distributed over the greater part of the Old World guide

in:

more or less local reputations for special efficacy. Sometimes a natural peculiarity leut awe to these waters and served to strengthen futh in their schem and the annual rise of the Nule are typical examples of such peah arities. The moment of the appearance of these unique phenomenassy unified to the faithful that the endowed waters had then attained the clumy of their currently powers.

In some instances the special attributes of the waters were disclosed by revolution or by happy experience to the pions. To some sources variety thus, the famous well of St. Irndiana and the waters of Silorim were efficienced in the Jordan abdominal disceases were healed at the well of St. Gin golph, and madness, sterility, and most other affections were cured by waters from appropriate sources. The Jordan, the Nile, the Ganges, the well at Limmons, and a few other holy waters possessed such wondrous powers that they acted practically as purace is

The waters of Betheada now rise almost unheeded, the pions blind as longer seek the one, all powerful well of St. Fridmann, and, except smeet he adherents of the Greek Church, faith in the properties of the sered waters of the Jordan is almost deal. As the popularity of one sent where the properties of the sered waters of the Jordan is almost deal. As the popularity of one sent churches, near the Pirenees, and that of St. Winfred at Holynell, in Wales, seem to have been transferred muny of the mariclous properties which centuries ago were vested in the holy places of the Orint From these wells wonderful cures are daily reported by eminent physician whose belief in the verity of the phenomena they record is above suspicion and borond question.

Although substances of greater potency, but of less traditional and spiritual force, have had their day and now are irretrievibly forgotice, water has preserved throughout the ages its reputation as a rincipal agent, owing largely to this fostering by religious bodies of fuffi in hidrotherapy

The rudely material benefits of bathing were early appreciated So widespread in ancent times was the custom of bathing that the Greeks and Lacedannomans bad not only private but public baths. Alexander the Greet is recorded to have marveled at the magnificence of the baths of the conquered Darius. But the aposities of bathing were the Romans The Romans clevated bathing to a cult. The splendor of their biths is a salient feature of their civilization. In the Roman conquests a bath was built as soon as the barbarrans gave the maders a moment's listence. The more settled the new colony the more cornate was the buth. Flaborate descriptions of these early baths and internumble dissertations upon tath.

The modus operants of these cures may be just as satisfactorily explained in other ways and moreover the cures can be performed in many other ways -Editor.

ing survive in the writings of many of the ancent nuthors, particularly Pliny, Seneca, and Jinven! The use of water alone was not fashonable even in the humblest baths. Oils performes, spaces, and other adjuvants enhined the asthetic pleasures of the constitutions. Together with bath m₀, the Lomana associated massage and physical exercises. The untrammeled license which characturized minument the public baths of the Romans brought by thinking under the han of the reforming zeal of the early Christian Brakers and perhaps conduct do the not overscruptions cleanliness which sometimes served to eke out the penance of the pious anchorites who retired into desert places, and to the strikin-ly magnificant role which water places in the rutalistic practices of the Christian church.

The Poman influence upon bathing is recentrated in our period partly because the Lomans were so prodigal in their hathing resources but fivund because our civilization is in direct succession to theirs. But knowledge of the cardinal uses of water probably dates from the dawn of man. The ancient Egyptians, Picts Celts Thirks Voroccius Japs Indians, and Mexicans all tweel forms of vapor boths. Besides baths of water—ieee, vapor hot, cold, river spring well and sea water—other media such as

sand mud neat, wine milk and even blood were used

The therapeutic use of water by physicians is as old as the art of medicine Hippocrates was hardly an enthusiast for baths but he advocated them under certain conditions in several of his writings. Celsus praised house baths but was reticent about the use of mineral waters Areteens of Cuppadocia Athengus, and Rufus of Ephesus wrote at length upon the merits of certain thermal baths. Agathmus was the apostle of cold baths Galen said little of baths Fallopius alluded to the diseases which may be benefited by the water at Lesbos Mitylene and other places Antylins, Oribasius, Atius, Paul of Agina Colinis Aurelianus and countless others through the ages lauded the uses of vater To enumerate the physicians who have practiced water treatment would be merely to catalog the fathers of medicine But until the scientific renaissance of the last century the properties and actions of water remained clouded in superstition and impiricism The pioneer work of Winternitz Brutenhach Baruch Theyer and others has now definitely established the physiological prin ciples upon which the action of water depends. Out of the chaos a certain amount of order and system has been evolved a rational basis for the therapeutic employment of water has been defined and the science of hydrotherapy which deals with the action of water upon the human body, has been erected

Here we shall confine our attention almost exclusively to water. The physical characters of water will first be considered, then the physiological principles of its virious actions will be dien ed, next the ways in which it can be used will be described, and finally, its application to discuse will be dealt with

### Properties of Water

A hrief outline of the properties of water is essential to a clear understraiding of its uses. Its distribution is universal. It exists in and can readily be transformed unto solid, hand, or exscons form.

Under ordinary atmospheric pressure, at the temperature of 0° C at becomes ice, between 0° and 100° C it is highed, about 100° C it easts as sterm. In changing from flind to ice a remarkable absorption of heat takes place if a kilogram of water at 0° C and a kilogram of water at 79° C be mixed the resulting mixture has a temperature of 30° 5° L, it is kilogram of ice at 0° C be added to a kilogram of water at 70° C, the ice disappears and two kilos of water with a temperature of 0° C remain. This liest obsorption explains the great efficacy of ice baths in biringuing about a lowering of temperature, in cross of forer

Similarly in passing from liquid to steam a tremendous amount of heat is rendered latent, hence allowing water to evaporate from a surface

is one of the hest means to produce cooling

is one or the next means to produce cooling.

Further vater has a great capacity for absorbing heat, thirthese times as much heat is required to ruise one unit of water through one degree of temperature as is required to raise one unit of platinum can degree.

Water cools relatively slowly It is therefore invaluable as a medium for abstracting heat, for storing heat, and for applying heat. Its utility as a thermal agent is further enhanced by the ease with which its temperature cut be measured, regulated, and controlled. As a fluid it mixes with solids to form pastes, the consistency of which can be altered at will, it also permeates most textures, so that its application can be restricted or adapted at will to any surface.

Water cin readily be applied with varying and regulated pressure

When water holds a small amount of a sait in solution it is one of the best of the electrical conductors and can be used to insure intimate contact between the body and electrodes, or a both may be arranged in a circuit, through which funde or gilvanic currents may be passed When currents are passed through aqueous solutions decomposition of electrolysis of the solution occurs

Thus, the constant current decomposes water into hydrogen and oxigen. The elements at the moment of liberation from their compounds are said to be mascent. The action of the mascent elements produced by such electrolysis is relatively powerful and is ntilized in certain forms of baths.

Water is thus an ideal medium for the application of cold and heat, electricity and pressure owing to the simplicity, precision, and rapidity with which these physical forces can through it be controlled. Its power

in combating disease depends almost solely on its property as a medium. Its physiological action, when a medium is essentially that of the physical force which it is conveying. We shall, therefore, before proceeding to discuss the specific therapeutic uses of water in detail briefly consider the various actions of heat cold, pressure and electricity upon the body

The chief sphere of hydratic medication is the skin. The physiologic action of water upon the skin is very simple. So far as hydrotherapy is concerned the skin may be regarded as a great sheet of imperfectly shell tered blood vessels and nerves. The effect produced by water upon the skin is merely the expression of the reaction of the blood ves els and nerves to the physical forces applied by the water Congestion or ischemia of a part depends upon the state of the blood flow in the capillaries the capillary system 1 controlled mainly by the contractibility or tone of the arterioles, and upon the condition of the arterioles hangs the efficiency of the whole circulatory mechanism

The skin is righly supplied with nerve terminals which are elaborated sometimes into special sensory end organs. Just as the network of vas cular capillaries opens into larger channels and thus lipks the peripheral circulation directly with the heart, so the terminal cutaneous ramifications of the sympathetic and sensory nerves are gathered together into trunks and pass to the central nervous system. A stimulus to the skin thus max powerfully affect the vascular and nervous arrangements of the whole body The skin is in fact an externalized regulating mechanism for the circulatory and nervous systems

Some areas of the skin have certain definite nervous relations to the Viscera

An organ may be reflexly influenced through a particular area of skin, and affections of organs may reflectly influence special skin areas Our knowledge of these areas we owe to Head and Mockenzie and it enables us so to guide and restrict our operations that by the simple bloodless pro cdures of hydrotheraps we can influence viscera with as much certainty as if we were exposing them by a surpical operation

The skin, however besides being an or an of sensibility has also secretory exerctory, and heat regulating functions. These are subservient to nervous and vascular control A stumplation of a cutaneous secretory nerve induces an increased flow of sweat and a local increase in the blood supply An increase in the blood supply usually involves an increased sweat secretion The heat regulation of the body is largely attained through the skin In overproduction of heat by excessive muscular action or in exposure to exce sive external heat the cutaneous capillaries dilate and sweating increases the evaporation of the sweat from the skin absorbs much of the surplus heat from the body. If exposed to cold the cuta neous vessels contract and sweating diminishes the body heat is thus conserved Urea, xanthin, and other decomposition products of protein

metabolism may be demonstrated in the sweat, the sweat glands, just like nearly all glands, have a vital selective affinity for certain substances circulating in their blood supply

But as the secretory, heat regulating, and exerctory mechanisms are merely outward evidences of viscular and nervous activities we shall firt consider the action upon these retivities of each of the physical forces

utilized in hydrotherapy

Physical agents such as cold act mainly by virtue of their irritant Within certain limits of intensity a stimulus to the din produces similar effects, whether it be caused by chemical or physical Weak entaneous protents narrow the arterioles and raise the blood pressure, the mereased peripheral resistance thus produced causes the heart to contract more rapidly. On the contrary, intense cutaneous irritants fatigue and paralyze the normally existing innervation of the blood vessels and produce a relaxation and dilatation of the peripheral arterioles with diminution of pressure, at the same time the inhibitory action of the pneumogastric slows and intensifies the cardiac contraction, and, when excessive, may praduce death by vagus tetanus

Gold -The application of cold is perceived with varying delicacy on different parts of the skin The local and general disturbances are dependent upon the degree and duration of the cold employed and the extent of the area to which it is applied, that is, to the intensity of the stimulus I ong continued application of severe cold deleteriously affects the vitain? of the tissues to a degree depending upon the resistance of the tissue et posed And when the cold is severe, besides the coldness, a pain element

is noticeable in the sensation

The application of sudden cold produces first a sharp inspiration, next a pause and then a long expiration which is followed by frequent and shallow breathing This reaction is the basis of one of the hest known and most efficient methods of resuscitation of the still born, indeed, it is alleged to be an essential stimulus to the establishment of respiration at birth In hrecch presentations, in which a premature onset of respiration might be attended by fat il consequences to the child, accoucheurs carefully swathe the extruded limbs in warm clothes The effect of cold is not confined to the respiratory mechanism, consciousness is stimulated by its application, as may be seen in the awakening of the dormant attention of hysteries, and in the sobering of the drunk, by cold affusions Cold is one of the most powerful nerve stimulants we possess

Owing to the stimulation of the cutaneous nerves the voluntary and involuntary muscles are influenced Imestigations by means of Mosso's ergograph have proved conclusively that cold is able to increase enor mously the resistance of muscle to fatigue, and also to restore the efficience for work to muscle which is already fatigued. A slight increase in the

Roehrig and \aumann quoted by Baruch

tometry of voluntary muscle is produced. And in involuntary muscle the stimulation is evident in "goost skin and in shivering

This increase of muscle tone and of muscular action and the vascular redistribution which they cause serve to augment animal heat and partly to compensate for that which is being lost Perceptible cold produces, partly by direct action and partly by reflex action upon the vasomotor center in the floor of the fourth ventricle a local constriction of the blood vessels. The blood is, in consequence diminished in the cooled part and a concomitant hyperemia is produced in other are is

The result of the contraction of the involuntary muscle fibers in the skin and of the sensory stimulus given to the central nervous system is a sudden diminution in the caliber of the cut incous capillaries This par rowing of the arterial and venous river bid raises the blood pressure. in creases the endocardial stimulation, and causes an automatic increase in the force and speed of the ventraular contractions

The increased cardiac action propels an augmented supply of blood through the capillaries which are thus expanded to the fullness of their capacity. The increased force of the heart is maintained for some considerable time

The contraction of the cutaneous vessels diminishes the skin secretion increases the blood pressure in the vessels of the deeper structures, and stimulates their vital processes. One well known consequence of this elevated blood pressure is diureus. The increased blood pressure the increased force and frequency of the heart's action and the increased blood supply to the kidney all tend to enhance the diuretic action of filos

James Tyson measured the amount of urine and urea excreted daily by a patient suffering from enteric fever who was being treated by cooling (Brand) baths. He found that the amount of urine secreted was vastly increased Before the Brind bathing was begun the urine, as is usual in februle conditions was scanty and very concentrated After the bathing as much as 1 980 ce of nrine was excreted duly. As the toxicity and the amount of contained solids were increased not only was the mechanical transudation of fluid through the Lidney augmented but the selective secretory properties of the rival epithelium were enliqueed also Experiments have proved that in addition to these changes there are

also remarkable alterations in the relative proportions of the corpuscular elements of the blood

Cold baths produce a lenkocytosis which persists at least for one and a half hours The increased flood pressure in the spleen and in the lym phitic glands, consequent on the general peripheral viscular contraction may wash out the white cells from these vi cera into the general circulation

The reestablishment of the normal ratio among the blood-cells in the course of one or two hours from the time of the cold application shows the alteration in the blood to be due to transitory changes in the circulatory system, in the cardino tone, and in the lumen of periphiral ressels.

Some observers have found an increase also of red cells

On the other hand, brief application of cold to the general body sur face results in an increased viscosity of the blood owing to the augmentation of the cellular elements

If the application of cold be local, remote effects are still produced These distant effects are of three classes First, owing to the constriction of the blood vessels locally, the blood is driven into other areas. Thus Winternitz demonstrated that a cold hip bath augmented the volume of the arm. This may be termed the remote general action. Second, there is the symmetrical or intermediate response, that which affects one of a pair of structures affects the other such is seen when, say, the right band is immersed in iced water, the left becomes blanched and cold. So great is this action that Thomson states that a thermometer held in the left hand shows a fall of 2° to 5° F under such circumstances and he records a case where, during an operation upon a divided palmar arch, he produced vascular constriction in the injured hand by immersing the sound hand in iced water, and was thus enabled to proceed with his ligature, unembarrassed by hemorrhage Third, there arise reflex influences upon subjacent or remote viscera. In popular medicine this third categor, is well recognized. Girls sometimes foolishly immerse their feet in cold water to arrest imminent menstrual flow on the eve of some entertain ment Bleeding from the nose is treated by allowing a cold key to wander down the hick. More precisely we now apply our treatment to Head's areas in order to insure the localization of the reflex action to the viscus which we desire to influence

In order to obtain a cold stimulus, what degree of cold must be employed? The body temperature in the audia is 984°F but the aretake temperature of the whole cutaneous surface when clad with customary garments is probably about 92°F (Winternitz) Hence to induce a 'cold reaction temperatures sensibly lower than 92°F must be employed,

If the cold be slight, the effect does not proceed beyond the stage of arteriole constriction enhanced cardine and respiratory action, and in creased missele tone. And these consequences are in variable degree transient. The vasoconstriction is followed soon by visiodilatation, but the beneficial effect upon the heart and the general misculature is more persistent. While in the cold bath, when the cold is mild, or after emerging if it be less mild, the cutaneous blood vessels dilate, the skin redders, a pleasurable sensition of warmin ensures, and a feeling of general well being prevails. Such is the "freaction" to the cold bath. To elect it in the sick great care is n-cessary to temper the stimulus to the patient's strength. The shock produced by the cold must not be too severe. The severity is mitigated by careful regulation of the temperature of the

water, by stimulating the skin either with the impact of mirriads of gas bubbles produced by aerating the water or with massage, and by shorten ing the duration of the bath

"Reat—As already stated, the unital effect of all forms of physical stumil is essentially the same hence the action of heat is not directly inverse to that of cold. All stumin produce initially vasconistriction but where is with cold this effect tends to be amintained with heat it is immediately superseded by vascollatation which persists as long as the heat. Owing to the vascular dilatation the sam raddens, a sensation of warmin previous, sweating increases and the deeper structures are depicted somewhat of their blood. The increase of the cutaneous blood sheet promotes radiation the eviporation of the evess of sweat renders latent a vast amount of heat, and the concomitant increased frequency of respirition abstricts much heat in the larger volume of expired in and water vapor hence, all these factors tend to cause as full of temperature. If the whole body be immersed in a bath of a temperature higher than 984° F the body temperature may be somewhile.

The relatively anomic condition induced in the vi cera minimizes their activities and thus heat tends to act as a general sedative. Also the direct action of heat upon the sensors perives is pleasurable and soothing. The seditive influence of heit is involuble in abolishing convolute seiz ures due to tonic conditions in children. The warm bath is the surest safest and simplest sedative for the irritable nervous system of infanct. The warm bath has now replaced the opiate strait jacket and padded come treatment of exestencing in mental disorders in most modern asylums.

The effects of heat and of cold on respiration appear to be somewhat similar cach produces at first a sharp inspiration next a pause, and then a long expiration which is followed by frequent and shallow breathing

On the other hand hot boths duminish the power of muscular work unless at the same time mechanical stimuli such as douches and rin arge are employed but even with these adjuvants the increase in efficiency is always to s than under the influence of cold applications.

Together with the incree ed muscular effort with which respiration is performed increased production of carbon diorud and increased absorption of oxygen occur also. This evidence of increased tissue respiration is due to the active hatabolism which the ti sues are undergoing in their effort to produce by combaston sufficient heat to compensate for that abstracted by the cold water. The effort is purily of reflex nervous origin (cf. the shivering) and partly consequent upon the flooding of the viscera by the blood which has been expelled from the constructed cutaneous circulation. Houghly speaking therefore we may regard the action of cold as tone, of heat as sedative.

In addition to its use as a medium for applying physical agents, water

is of great service as a solvent. It is the most universal of all solvents, the vehicle for the administration of all soluble drugs

Water is given to remove in solution or in suspension noxious material, not only from the surface of the body, but also from its apertures and the cavities into which these apertures open. The bladder, uterus, rectum, colon, and stomach are all subject to its elements again.

Water is introduced within the lymph vascular circulation through the mouth and rectum subentaneously, intraperitorically, and intravenously, in order to dilute circulating toxins. By mixing these toxins less conceintated, water makes them less poisonous. It is similarly administered in cases of shock, particularly shock arising from hemorrhage, in order to refill the depleted vascular system and to provide endocardial simulation to the failing heart. These diluting and refilling actions are especially aduable in septic conditions, such as forms of scurvy, in which toxina is complicated by profuse hemorrhages from mucous surfaces, and in discases, such as cholera infantum, in which toximia coevists with profuse waters alive discharges.

Water may be so completely contained in a membrane that no leaking or cozing occurs and salt may be dissolved in the water to the point of saturation without impairing the containing power of the membrane But, if a membrane perfectly containing an aqueous solution of salt be pliced in contact with a weaker aqueous saline solution, or with water containing no salt, an interchange takes place through the membrane, so that the salt content of the water inside the membrane becomes equal to the salt content of the water outside the membrine Salt diffuses from the more to the less salty solution, and water, from the less to the more concentrated solution This diffusion is called osmosis The more con centrated fluid is said to have the higher osmotic pressure, and the diffusion ceases when the osmotic pressure on both sides of the separating membrane is equal Osmosis is one of the most important physical processes in life It is a determinant of the movements of all the body fluids and promotes the distribution and elimination of the contents of these fluids Water has a lower osmotic pressure than human serum, so, when swallowed, water passes through the membranous bowel into the lymph vascular capillanes. Water containing so much saline in solution that it is of higher osmotic pressure than the serum causes diffusion of fluid from the lymph vascular capillaries into the bowel lumen Thus do saline catharics produce copious water, stools Just is osmosis occurs between the bowel contents and the contents of the lymph vascular capillaries so does it occur between the contents of every living cell and the fluid bathing that cell

The principle of o-mosis has been applied by Sir Almroth Wright, the distinguished Irish hacteriologist, to the treatment of septic guishof wounds. Antiseptics generally are protoplasmic poisons. The best anti-

septies are those which are highly destructive to the protoplasm of bacteria and relatively harmless to the healthy human cell

Anticeptics, bowere, are almost invariably additional destructive agents menacing the life of the dama_ed cells in a wound. After careful observation of the unfortunite effect of antiseptics upon wounds arising in modern war, Wright discarded antiseptics in favor of the bland and uniformly beneficent stime solution. Since solutions wash wounds free from all uncleanness emidate debris and surface organisms dissolved dulte and disperse toxins and by ossuess mechanically reletive cells of their diffusible novious contents. The institute resistance of the tissues is thus greatly reenforced and the optimal conditions for local repair are casured. The brilliant results alreads achieved by Wright with this mithod of treating septic wounds make this new application of hydro therapy one of the most important detructs in surgery of our time

# MODE OF APPLICATION

The means employed to apply water are unnumerable. Many elaborate apparatus have been devised but in proportion as their complexity increases, their u effiliess as a rule decreuse. Indeed, all the essential principles upon which hydrotherapy is by of may be utilized through primitive domestic appliance. The ordinary full bath partial baths such as hip baths, shower and donche boths wrapping in wet sheets, and the application of compresses are the most important means by which water is applied. The temperature is either minimized as constant as is possible throughout the procedure, or it is designed by varied.

The water baths may be medicated in various ways. Salt water biths (one-third of a pound of salt to each gallon of water) alkaline baths (one-fifth ounce of sodium carbonate or one-tenth ounce potassium ear bonate per gallon) teid baths (one-third ounce dilute nitrobadrochloric acid per gallon) mustard bran aromatic baths such as lavender and pine mercurial, aumoniated sulphiniated and countless other varieties are employed.

The purpose of this medication is to add to the temperature effects, bland or irritating sedative or stimulant action of the medicament

Stimulant action is obtained not only by appropriate temperatures and medication, but also by smithly regulation of the duration of the application. At Nuoheum stimulation is enhanced by the impact of hosts of bubbles of carbonic acid gas upon the kin. Missages and friction bring about a similar but more powerful action. By projecting water at high pressure against the body—donelies needle sprays—a similar result is obtained concenitant with the action of the water.

Hence, temperature irritation or sedation and pressure, may all be readily upplied by means of baths. The practitioner, to employ the remedial measure satisfactorily, must first clearly recognize the preuseffects he wishes to attain, then consider what means are most simple most practical, and most certain to procure these effects. There is nothing absolute in the facts herein set forth for the use of baths in various could turns. These facts are gleaned from standard authorities such as Winter nitz, Baruch, Schott, and others. They are meant merely as guides to treatment. No one slavishly follows the pharmacopeal dose of drug Lach patient is a new experiment. So the temperature, duration, composition, and frequency of the bath, and the use of pressure, or massage, must be as excefully considered and as judiciously altered as the design of drugs would be

The both may be general, or local, either applied to the entire body surface, or only to some part. The water may be brought into direct con tact with the skin, or another medium, as a sheet, may be made the vehicle

for its use

General Baths—The Abbution—An oilcich or rubber sheet, correct with a blanket, upon which is laid a sheet, is prepared on the bed of the patient. Each part of the body is consecutively exposed, a wet tored wring out of water is laid on the uncovered area. With the flat of the hand rubbing is applied through the towel and then the towel is rumored and the part dried. When the whole body is to be treated in this way it is best to take the parts in definite order. This is the method of Winternitz.

Baruch recommends for much we kened patients the following procedure. On the day following a warm cleaning that the patient if wrapped in long hursed blankets, one passing around the body, under the arms, and inclosing separately the lower extremities, another enfolds the arms at the sides, and is tucked in about the neck and under the feet. Heat is thus accumulated at the surface. In one-half to one hour the face is washed with water at a temperature of 50° T. Next each part is in turn battch, rubbed, direct by gentle frestion, and re covered.

When the patient has become accustomed to this the ablution may be

When the patient has become accustomed to this the adultum my given with the subject standing. He struds in twelve inches of water it 100° F, the attendant washing him down with his hands or with a towel, and pouring on parts of the body water at a temperature initially 80°F,

but daily lessening till it reaches 60° F

Patients unaccustomed to cold water may begin by a partial ablation involving only the face, neck, and chest, and gradually including the whole body

Ablutions should always be rapidly performed. They are useful not merely as stimulants of the peripheral nerves and vessels, but also by the raction induced, as an index to the state of the patient. They are made employed as a preparation for other forms of hydrotherapeutic treatment

The Half Bath -There should be in the bathtuh enough water to im

merse the pelvis and it should be at a temperature of 70° ° T to 85° ° F.

To preent retrostanal congestion the patient shead is wrapped in a cold
most towel. The face is first bathed T be attendant then with one hand
throws water from a vessel over the front of the body, and with the other
meanwhile, rubs the back. Colder water is used until the patient feels
cold, should his treth chatter he should be immediately taken from the
bath. A warm dry sheet previously prepared, is then folded about the
putient, and with it he is drived.

Affusions—Water at a temperature of JO F to 65° F is poured from above on the patient who sits in the empty tub or hes on a ribber of I he degree, of stimulation is in propriotion to the temperature of the water employed and the height from which it is allowed to descend upon the subject, that is the lower the temperature, and the friater the height the greater the stimulation. This treatment should be very quickly given. In acute cases the patient atts or hes in chromic cases he stands in water at a temperature of 100° F.

By means of the affusion the servery cutantous nerves over a large area are mechanically and thermally simulated and a reflex action on the heart, respiration and metabolic functions ensues. The intermittent nature of the simulation mericases the effect produced

Affusions should be used with caution with precision as to tempera ture and with due regard to the patient's power of reaction

The Sheef Bah.—A rubber sheet and a blanket are listed on one side of the bed, or on an adjourn, bed. There should also be in readiness several hinen sheets, coarse or fine according to the effect desired, a timb of water, a cup, and a sponge. The linen sheet is writing out of water at 50° F to 80° F, spread queckly on the rubber sheet the patient whose head and face have been bathed in ic. water and who e head his been wrapped in a cold wet towel to present introvatiand congestion, is laid on the sheet. Systematically, small areas of the body in succession are warmed by gentle friction. As soon as a prit is bested a cup of cold water of 1° F to 50° F, is poured on it. This procedure is continued till the patient feels cold or charter markedly. Sometimes the subject is permitted to remain in the wet sheet for half an hour then often a gentle sleep follows. The first effect of the cold wet sheet is to contract the perplicial vessels in the sheet of the cold water then agun contracts them and so the process continues.

Drug Sheet —The drug sheet is a modification of the sheet bath. The room in which this measure is earned out should have a temperature of not less than 70. It. The patient with a wet fowel on his head, strinds in tacket inches of water at 100. F. A drupping sheet, wet with water at 70. It, is placed over his shoulders under the right arm acro is the back over the left shoulder across the front, and over the right arm. Quick

remedial measure satisfactorily, must first clearly recognize the presented to wishes to attain, then consider what measure are most simple most pretered, and most certain to procure these effects. There is nothing absolute in the facts herein set forth for the use of biths in various could it to the facts herein set forth for the use of biths in various could not the facts are gleined from standard authorities such as Windmitz, Barneb, Schott, and others. They are meant increly as guids to treatment. No one slavishly follows the pharmacoperal dose of drugs and the standard preparation, and frequency of the hith, and the use of pressure, or missage, must be as errefully considered and as judiciously altered as the design of drugs would be

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to react should be tested and educated by other hydrotherapeutic measures before wet packs are given

In the cold wet pack there is an initial bock lasting from five to twenty minutes. This is followed by a hyperenne cutaneous reaction. There is an interchange between the cooled flood of the perspheral circulation and the warm blood from the viscera which continues until the sheit is thoroughly warm. The everetism of the skin is increased and towns are, climinated. The wet pixl also has a calming effect due to withdrawal of blood from the brain and the exclusion of external cutaneous stimuli. To ceutre the anthrip-retic exton the water for the initial pack should be 60° F to 70° F. When the first pack is warm the patient should be put into another wet with water 2. F warmer A soon as the second pack is warm the procedure mix be repeated raising again the temperature, of the water employed 2. F. This is done till four or five packs have been given or until the bods temperature be satisfactorily reduced. If the pack be given for its sedative action and sleep follow the patient should be permitted to remum in the pack till he awakes a cold abutton should then be given.

Hot Blanket Pack —Three or four blankets are laid on the bed one blanket is wrine, out of water is hot as can be borne by the hands, and spread on the bed. The patient is folded in this and covered by the other blankets. After a cold wet pack the sheet is warm, but after a hot blanket pack the wet blanket is cool showing that there has been a diminution of heat production.

The Wet Compress —Almost all forms of the compress consist essentially of a linen beas which is the vehicle for the application of the water and a dry fluined banda, c which covers and secures it. These vary only in slape and size to suit the rigina of the body to which they are to be

applied, and in the temperature of the water used

The cold compre's causes contraction of the peripheral vessels and should therefore, be renewed frequently enough to keep it a cold application. When the stimulating compre's is employed the water is at 50° F and the compress is permitted to remain us safe till it is warm or even dry. When covered with waterproof in iterial the compress becomes a surgical wet die sing, astringents or alcohol are often used for wetting. It is so difficult to keep water compresses hot and so unconvenient to handle them that better heat retriuting media, such as the lin ced compress, are much used.

If the temperature of the petient be high the compress should be changed every half hour others to every hour might and day unless the patient is askep. Fresh water should be used and the compress hould every day to prevent expite infection of the skin

The 1bdominal Compress - The linen used for this compress should be in three layers of sufficient width to extend from the xiphoid process

strokes and occasional slaps are made by the operator up and down over the sheet. Twice or three during the procedure a basin of water, 10° F or 15° F colder than the water in which the sheet has been dipped, is poured over the head and shoulders of the patient, in the intervals friction for five to ten minutes is applied. On removing the sheet—which should be rapidly done—the skin is hyperemie. The patient then steps out upon a wootlen rug or blanket, is completely dried with soft linen towels, and then rubbed down with a warm sheet or towel. If this bath greatly tatigues the patient, its durition should be lessened till the reaction and resistance are strengthened.

The strength of standardon in this measure may be greatly varied by varying any one or more of the factors, temperature, fraction, the we of course or moe sheets, the use of the sheet dripping or well wrung of the frequency of the applications of cold water during the process, and the duration or the bath

If the hands and feet are cold even on arising it is well to induce the fit to accumulate before the sheet bith is given, by piling on blankets, by giving a wet pick for one-half to one bour, or by a vapor bath for a few minutes

The Cold Rub the Cold Sponge—On arising, before losing the temperature of bed, the patient is wrapped in a sheet well wring out of water, temperature 60° F to 75° F, and is very actively rubbed down, with frequent slapping to produce an active hyperama of the sam. After rapid dring and the administration of a cup of hot milk the patient is sent out for a walk.

The Het Pack -A rubber sheet is covered by a large blanket, which hangs over one side of the bed and down over its foot. A large coars sheet, very well wring out of water at 60° F to 70° F, the temperature being varied to suit the case is spread on the blanket The patient, his head in a wet turban, his down with upstretched arms, the right side of the sheet is brought under the arms across the front of the body, and be-and tucked in at the neck and feet The blanket is then drawn firmly about the patient and tucked in at the sides, neck, and feet 'Everything depends upon complete exclusion of air from beneath the blanket cover If the patient is chilly he should be covered with blankets Partial packs, including only the body below the axilla, may be given The pack lasts one half to one hour The effect varies with the duration, the texture of the sheet, the temperature of the water, the extent of the pack, and the frequency and number of times it is repeated. To restore the tone of the cutaneous vessels which have been relaxed by the wet pack, the half bath, the sheet bath or the cold ablution should follow In the wet pack the reaction is entirely dependent upon the patient's capacity. If the skin be previously warm the reaction is better. The power of the patient

procedure, such as the wet pack. The face and neck should first be bathed with very cold water, and the plunge bath then entered suddenly. The whole body should be immersed in the water the head also being dipped several times. The buther should exercise or rith himself in the water the plunge bath should list from a few seconds to two or three musters It should be followed by togerous rubbins. As soon as dry the patient should exercise moderately or be may uge

The Warm Full Bath -- Any bath with a temperature above that of

the skin (92° F ) Baruch designates a warm bath

The temperature of the room in which a warm bith is given should be between 70 F and 80 T Warm towels and a warm sheet and several obstacted for the several hot water bags should be in readness. If there is no hot water on tap tabs of water at a temperature of 200 T should be prepared so that he bath temperature, may be raised at any time if necessary. The water in the bath should have a temperature of 9 F (Baruch) it is also used at temperatures between 98 F and 104 F. The patient wets his face and neck with the water in the tab before entering it. He lies down in the bath and should remain immer of to the chin. The duration of the bath varies with the conditions for which it is administered. Something warm should be provided for the patient to step out upon the warm sheet is rapidly folded around him and he is put into a warm bed and covered with Hankets. After a few minutes he is dried. Profise perspiration is to be a windle.

When the bith is warm the irritability of the sensory nerve endings is decreased, the bith has therefore a sedutive effect. A hot bath—one

above 100 -has a directly opposite action

The Continuous or Hammock Bath -The ordinary bathtub is usually too small for this purpose So that the patient may be able to repose in comfort for a prolonged period he is suspended in a hammocklike arrangement, which should clear the bottom of the tub Suitable rests should be provided for the head and nates. If the size of the bathtub be adequate a hammock bath can be easily improvised at home opposite one another, along each of the two sides of a large sheet, four to six pieces of stout bundance are stitched. The pieces must be long enough to allow the free cuds of any par to be tied under the bathtub, when the middle of the heet rests upon the lattom of the tub. After the patient has been placed in the bith upon the sheet the corresponding free ends of each pair are pulled intil they are so tightened that the part of the hody which their section of the sheet supports is made to assume the optimal position for its comfort. Strips of bandage six inches wide may be used and the sheet altogether dispensed with. If the bithinb rests directly on the floor stont wire should be twisted into Sahaped hooks one curve of the S hooks on to the side of the bith to the other curve which should be within the 1 ith the supporting buildage is fixed. An India

to the symphysis pubis, and fall over the sides of the trunk. The water out of which this cloth is wring should be at a temperature of 60° F to  $70^\circ$  F.

The Neptune Girdle—The Neptune girdle is a modification of the above compress. The linen is made long enough to energie the body and form a double fold on the abdomen. It is covered by a dry linen or flaund binder, and is changed twice or thrice in the twenty four hours, the part boing sponged with cold water before each renewal

The Combination Compress of Winternit.—The Neptine girdle is applied as described A leater onl, irranged to have hot water passed through it, is laid on the epigastrium. This hastens the reaction, and reflectly stimulates the nerves of the underlying organs. When a compress is employed to reduce influentiation it should be frequently changed, never being permitted to become warm. The object here is to keep the vessels of the inflamed part in a site of contraction. The temperature should not be so low as to paralyze the eutaneous vissels, nor so high as to dilate them. To attain the desired end a temperature of 50° F to 60° F is suitable.

Cold Applied to the Head.—Instead of using the clums ice-biwhich wets the pillow, a wet cloth may be laid on the head and held in position by a cap of coiled rubber tubing through which ice water flows

The Full Bath —This may be given hot or cold, with or without fretion. The cold full bath has become intimately associated with the name of Brand in the therapy of typhoid fever. Brand's method for the cold full frection bath is described later.

Another form of the cold full bath is the graduated hath of von
Ziemssen. The patient is placed in a tub which is partially filled with
water at a temperature of 86° F to 90° F, and to which water of a tem
perature of 40° F is added till a temperature of about 77° F is attained.
Friction is used, and the bath lasts one-half hour. The patient, on emerg
ing, is allowed to remain in warm blankets for fifteen minutes before be
is dried and dressed.

Winternitz recommends the employment of alternate half and whole cold baths, the former at a temperature of 60° F to 68 F, the latter at a temperature of 42° F to 50 F. The patient remains in the half bath one to two minutes, then steps into the other for one-half to one minute, continuing the alternation according to the extent of the desired reaction.

As a hydratic measure the cold full bath requires the strongest reactive response from the patient, it is therefore necessary especially at the reactive power is weakened in the sick, to bring to its aid the friction musticd upon by Brand and his followers

The Cold Plunge —This bath should not be entered if the subject field chilly If necessary the skin should be previon by warmed by some other

to this treatment. The sitz bath acts on the abdominal and pelvic organs and vessels, its action depending, as in other forms of haths on the tem perature of the water and on the duration of the bith. Other partial baths are the occupital bath, the elbow the hand, and the foot baths.

The Elbou Bath.—The elbow is kept in a vessel of running cold water for ten to twenty minutes. Hand and foot haths are given in the same

way, but the water may be used cold or hot

Application of Extreme Temperatures—"team and Hot-air Baths—
These are commonly given in calabasets which nolose the entre body with
the exception of the head. The head ind neck must be cooled during the
bath. The temperature of the lith usually 104° F. though possibly
higher, is attained gradually as the stane enters. The duration of the
bath varies with the indications rarely bein, more than thirty minutes.
Winternitz has devised a method for a steam both at home. A wooden
rithike frame lice at the bottom of the tub on which the bather is ruised
from the floor of the tub. A containum flow of hot water gives off steam
in the tub, which is well covered to prevent its escape. Higher temperatures can be borne in hot air than in steam boths and in steam than in
lice water. The linth causes ripid dilation of the entaneous ex-sels, followed in a few minutes by sweiting. To increase the perspiration oold
water is given to the patient to drink. It is best after the hath to employ
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The radiant heat from electric light is utilized to confer temperatures of soveril hundred degrees. These temperatures can be easily tolerated for some time provided the part to be heated is dry and is enveloped in wool or other absorbing material so that perspirition may not gather suitable as thed, a limb can comfortably endure a temperature of 20°C for half an bour. The apparatus made by Dowsing and by Tyravier for administring ridi int heat is viry practical. The ingenious Bergonius suitables the heit developed by interposing resistance in an electric circuit in such a manner that he can project last through the tissues so that it converges inpon a desired focus in an origin or structure vet does not larm the skin. This 'drithermi' has already proved of great worth. The application of heit generated by electricity will be fully disensed in the section decling with electricity.

Lussun Bith - The Russian bith is a form of steam bith

Irish Loman Baths — Iri h I omin biths are hot air biths where the pittest cuters a cries of rooms filled with air of increasingly higher temperature

Ice—Thi most common way of applying extreme cold as by means of the ordinary ice-big the n e of cold tubin, the Leiter coll through which rec water is passed as however preferable. The tubing is colled in any form to fit the pirt to which it is to be applied. The ce craftle is an ordinary hospital craftle placed over the chet is abdomen or entire rubber air ring makes a good head rest for the bather The temperature of the water should be 95° F to 100° F The water may be chan el once in twenty four hours, or a constant inflow and outflow may be arranged Before the nationt enters the bath his skin is anointed with a fit-landin or vischin-is saturation may cause hriveling and pechn It is desirable to have the tub rused from the floor and covered with blankets to exclude air and prevent exposure. A wooden board may be placed across the tub to support the blankets, and also to serie as a tray for the putient's meals. The present may be lifted from the tub to evacuate the bowels and bladder, or the urine and feces may be permutted to pass anickly away in the outflow. A patient is kept in the con tumous both for any length of time, from a few hours to more than a year. The continuous warm bath quiets the mental excitement of the mid particularly of mimacs who have cold or evanotic extramities. Its seda tive effect upon convulsive movements in children is remarkable. In septio wounds especially wounds of the bladder and abdomen, it cannot be too highly recommended In septic wounds of the limbs, arm, foot, or leg local baths are preferable, for in the hammock bath a B coli infection is soon added to the original sepsis. I have never seen this B coll infer tion assume a menucing form, but it is both unpleasant and undesirable When a septic wound is complicated by fracture of the bones, continuous arrigation, or frequently renewed value compresses are usually preferable to baths, for boths necessitate painful and much to be deprecated movement of the broken homes Douches -In the douche a column of water descends from a height

Bouches—In the douche a column of water descends from a next. There is thus obtained the mechanical attoo of the pressure of the water as well as the effect of its temperatur. Many forms of the douche est. The vertical run douche is a shouch bath, in which the water fulls from a perforated nozzle or rose. The jet or fan douche is a morable arrivement to direct a column of water upon any pirt. The secending or permeal douche is a spray of water, directed inpuzard, over which the patient sits on a stool with a ring shaped sent. In the circular douche the water is directed horizont illy inward from circular tiers of perforated metal tubing. The Scotch douche, or alternating douche, applies heat and cold alternately, either live site um and cold water being alternated or warm water being used in place of the steam. Carbon droud and hot air are also applied by means of douches. As these are measures which are mostly practicable in institutions only they will not be further considered there.

Hip or Sit. Bath —The tub used for this bath is familiar. The tem persture of this bath is varied, it may be cold, tepid, warm, or hot. Then should be enough water to reach to the unblicus of the patient when he is seated in the tub. The patient should be carefull; covered to protet him from chilling. Triction of the upper part of the body may be added

to this treatment. The sitz bath acts on the abdominal and pelvic organs and vessels, its action depending as in other forms of baths on the temperature of the water and on the duration of the bath. Other partial baths are the occupital bath, the elbow the hand, and the foot baths

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Ice—The most common way of applying extreme cold is by means of the ordinary ice-brig the mse of colled tabing the Lecter coll, through which ice water is pressed is however preferable. The tubing is colled in any form to fit the part to which it is to be applied. The ice cridle is an ordinary hospital cridle placed over the chest addingen or entire bedy The patient is stripped. Ice-bags or pails of ice are hung from the pole of the cradle, and the whole covered over with a thin sheet. The patient is kept in the ice cradle till his temperature is sufficiently reduced. A hot water bug is kept at his feet to prevent chilling.

Ice Rub — The ree rub is given by means of a flattened piece of re in a cloth with which the parts of the body are rubbed in succession.

Ice Pack —The patient is stripped, and enveloped in a cold wet sheet. An ice-cap is laid on his head, and pieces of ice, carefully smalled, are placed at his sides. He is rubbed by the nurse with pieces of ice, the ice rub. Other methods of using extreme temperatures are the size and ethyl chlorid sprays and the application of carbon dioxid snow.

General Observations - Hydrotherapeutic applications are extremely valuable agents, but if skill, precision, and judgment be not employed in prescribing and in administering them they may cause great injury General cold applications should never be given in states of collapse or in exhaustion, if the temperature be subnormal, during a chill, or during a hemorrhage A patient must be warm before he is subjected to general When there is any suspicion of reactive weakness, the reactive capacity of the patient must be carefully trained by gradually lowering the temperature of the water, and by slowly increasing the duration of the bath, meanwhile, mechanical stimulation of the skin through aerating the water or through friction should be employed However, in the treat ment of tuherculosis Aberg advises the giving of cold full baths without preparatory training of the patient Full biths of high temperature must be used with great caution In arteriosclerosis renal disease, and cerebral hyperemia, during such hot boths cold must be applied to the head to prevent the danger of an excessive flow of blood from the stimulated body surface to the head (Winternitz's "retrograde hypostatic conges tion") My mistakes have occurred in the use of hot baths for comatoes children Even when the greatest gentlenes is used, moving the mornhund may precipitate death and the sudden dilatation of the cutaneous capil laries which follows immersion in the warm bath may so reduce the endo cardial stimulation in cases where diarrhea or hemorrhage has depleted the vascular system, as to cause the heart to stop beating The hydrothera pist has not the protecting secrecy of the operating room. If the end comes while the patient is in a hath the relatives may consider the sanctity of death profuned before their eyes So it is well in cases of extreme exhaustion to use strychnin, transfusion pituitar; extract or other stimu lants, before invoking the restorative power of the warm bath

Local applications of heat or cold have little influence on general conditions, but we find few contra industrious for them. Local heat should not be applied for the aborting of a circumscribed inflammation as it raises the temperature of the diseased part, increases the congestion, and favors pus formation. Local cold, however, is valuable, for it has the con-

trary effect to heat As an analgesic either may serve Cold is usually better in pain from inflammation for it not only diminishes exudation and thus spares the inflamed nerves from pressure, but it has an analgesic effect on the names. Heat is very serviceable in pain caused by nerve lesions Sometimes trial alone can decide which should be used must be remembered that severe celd too lon, applied may impair the vitality of the tissues A protecting laver of gauze should intervene between ice and the skin and the application should be discontinued for at least fifteen minutes every hour

Although hydrotherapy may evert not merely a palliative but often even a curative influence, its habitual use may create a perpicious tendency to rely mainly or exclusively upon it. Other forms of therapy—crum drug dietetic psychic physical and operative—should have unprejudiced consideration in the mind of the rational physician, so that the nationt s rights may be sacrificed neither to therapeutic habit nor to therapeutic

bigotry

#### SPECIAL HYDROTHERAPY

## DISEASES OF THE CIPCLEATORY SYSTEM

The hydrotherapy of circulatory di cases is very simple. Through stimulation of the cutaneous nerves by means of cold water charged with salts and gas, or turpentine or ammonia or other mild irritant vasceon striction is produced in one set of arterioles and a vasodilatation in another Concervably also the stimulation reflexly influences the heart muscle itself The vasomotor changes produce endocardial stimulation by raising the blood pressure But together with the rise there is dilatation of the visceral arterioles so that the blood is driven into and through the stagmant parts of the circulatory system The nutrition of organs in which stass is a menace is thus improved The heart is made regularly mildly and effectively to act. The coronary capillaries may share in the blood redistribution and the heart thus benefit directly from the bath But there is as yet no proof of any special implication of the coronary erculation Doubtless however cardiac nutrition is enhanced by the steadying and slowing influence of the discreetly increased blood pressure It is as it were a mild and beneficial evercise which the heart enjoys The lowing of the rate and the regular rising of the cardiac rhythm not only enables the heart effectively to empty its cavities, but in the pro longed diastoles an opportunity for regular and systematic flooding of the coronary capillaries occurs and the nutrition of the heart muscle improves

The application of cold to the precordium will slow the rapidity of an irritable and infected heart. It is a valuable administ to the treatment of endocarditis and pericarditis as it moderates the fevered activity and saves the eardine muscle from undne exbrustion. Moreover, in valvular lesions, this tranquilizing of the heart spares the fringle, edemators, infiltrated valves from as many impacts as the bests that are accorded. Precordial cold applied causes also a dilatation of the vessels in the heart muscle and in the pericardium, and thus aids in repelling the bieteral invision by augmenting the blood sumply.

Heat cautiously applied to the precordinm may stimulate the heat to more forcible, more regular, and more efficient contraction. It also, reflexly, causes a construction of the coronary vessels. In work, distended, dilated hearts the application of heat may act as a powerful stimulas and soon strengthen, regularize, and increase the amplitude of the miles and

diminish the area of cardiac duluess

Arteriosclerosis -- It is of are it importance to recall the dual relation which the increased peripheral resistance maintains in this common malady It serves, not only as a cause, but also as an effect When faulty dilatation of the vessels exists there ensues an imperfect climination of unknown products of metabolism which lead to a toximia. This in erease of circulating toxins mainly by direct action on the vessel walls, but perhaps indirectly also, through the vasomotor nerves, gives rise to a spasm of the vessels which, in turn, leads to a still more senty blood flow, as climination is dependent upon the rate of renewal of the blood in the emunctory or, ans, such a decrease in the vascular supply serves to emplo depuration still more. Thus a vicious circle is instituted and the toremis increases The increased resistance to the vascular current in turn places added work upon the heart, which at first hypertrophics and later frequently dilates as invocardial changes occur. As, except for temporary effect, drugs should not be given to obtain the desired visedilitation, hydriatric measures possess a particular value in the treatment of selerotic vessels Bs hydrotherapy it is possible to reduce the midue constricted of the vessels thus to augment the blood flow and to promote climination The partial rub at a temperature of 68° T is best suited to be the initial measure If the patient withstands this mild procedure, after a few dies more stimulating measures, such as the full cold rub, preferably at a lower temperature, should be unstituted. The duration of the rub 15 governed by the reaction. The applications of cold to the precordinm and head are indicated not only to meet the effect of the discussion the cir. culatory mechanism, but also to counteract the added strain placed thereon by disphoretic measures The steam bath of moderate duration and terr perature, not exceeding 110° F, when used in arterioselerosy as a dispheretic must be conjoined with cold applied to the precordial region and head. The employment of the hot bath, 95° to 100° E, is of great service. Venous sluggishness yields often to running foot halls.

Endocarditis—Acute—In all cases of acute endocarditis the application of cold to the precordinm is indicated, as by this meisure cardiac solution is secured and the possibility of the occurrence of embolism is munimized. The applications of choice are the precordial coil and the ice by Th. selected one should be kept in pluce continuously for a period of, say, several days, unless the heart shows agins of weakness. In the prisance of non-inflammatory impogradual changes cold precordial applications must be used with caution or not at all. Partial rubs later in the course of the disease are advocated.

Chronic -I ocal stimulation of the heart obtained by the use of the cold precordial coil is practiced. It is claimed that digitalis may be sup-planted by this application. The use of heat to induce general invigoration and to reduce peripheral resistance is advisable but only under extreme caution, as the temporary mereased activity resulting from thermic measures may be most potent in producing cardial dilutation Diaphoretic measures, as wet packs, partial rubs and the Winternitz modified steam bath applied five to ten minutes are of value in reduction of edema The last consi ts in exposing to steam the lower parts of the body while to the precordium is applied a cold coil to reduce the danger of dilatation Irregular or breken compensation and cardiac insufficiency require careful hydriatric mana_cment Much depends upon the changes in the heart muscle. The use of the earcfully graduated partial ablution (68 F) for several days and then the application of the cold precordial coil are the usual treatment. It there be undue vascular construction present in the cardiac insufficiency general measures may be applied to climinate it Prominent smong general measures may be mentioned the Nuheim or Schott treatment

Hemorrhoids—This aggravating malads often yields to brief, cold site baths of about 85 F temperature. Hot hip baths are valuable to relieve prin and to ensure cleanliness and aboutld be given night and morning. After every evacuation of the bowels cleanliness should be attained by cold somening.

Acute Percenditis—The me-hag or cold I enter coil is applied continuously to the precordium with the same precaution observed in acute endocarditis. These measures evert decided analysise and anti-inflam matory effect. Hyperpyrevia is treated with extremely cold half baths Daphorettic measures, particularly the wet pack for two hours, are in detacted by an obstinate efficiasion.

# DISEASES OF THE RESPIRATORY TRACE

Asthma — A brief application of cold to the nape of the neck effects relief in bronchial asthma depending upon masal conditions. The form used may be an affusion, or a douche under ten pounds pressure

saves the cardiac muscle from undue exhaustion. Moreover, in valual lesions, this tranquilizing of the heart spares the fragile, edenator, unfiltrated valves from as many impacts as the beats that are swided Precordial cold applied causes also a dilatation of the vessels in the heart muscle and in the pericurdium, and thus aids in repelling the bacterial invasion by augmenting the blood supply.

Heat cautiously applied to the precordium may stimulate the heat to more foreible, more regular, and more efficient contraction. It, sla, reflexly, causes a construction of the coronary vessels. In wesh, distended, dulated hearts the application of heat may not as a powerful stimulus and soon strengthen, regularize, and increase the amplitude of the pulse, and

diminish the area of cardiac dulness

Arteriosclerosis -It is of great importance to recall the dual relation which the increased peripheral resistance maintains in this common malady It serves, not only as a cause, but also as an effect When faulty dilatation of the vessels exists there ensues an imperfect elimination of unknown products of metabolism which lead to a toxemia. This in creaso of circulating toxins mainly by direct action on the sessel walls hut perhaps indirectly also through the vasomotor nerves, gives rise to a spasm of the ves els which, in turn, leads to a still more seanty blood flow, as elimination is dependent upon the rate of renewal of the blood in the emunetory organs, such a decrease in the vascular supply serves to cripple depuration still more Thus a vicious circle is in tituted and the toxemia increases The increased resistance to the viscular current in turn places added work upon the heart, which at first hypertrophies and later frequently dilates as invocardial changes occur As, except for temporary effect, drugs should not be given to obtain the desired vasodilatation hydriatric measures possess a particular value in the treatment of sclerotic vessels By hydrotherapy it is possible to reduce the undue constriction of the vessels, thus to angment the blood flow and to promote climinition. The partial rub at a temperature of 68° F is best suited to be the initial measure If the patient withstands this mild procedure, after a few days more stimulating measures such as the full cold rub, preferably at a lower temperature should be instituted. The duration of the rub is governed by the reaction The applications of cold to the precordium and head are indicated not only to meet the effect of the disease on the cir culatory mechanism, but al o to counteract the added strain placed thereon by diaphoretic measures The steam bath of moderate duration and tem perature, not exceeding 140° F, when used in arteriosclerosis is a da phoretic must be conjoined with cold applied to the precordial region and head The employment of the hot bath, 95° to 100° F, 18 of great service Venous sluggishness yields often to running foot baths

Endocarditis—Acute—In all cases of acute endocarditis the application of cold to the precordnum is indicated as by this measure cardiac

respirators or cardiae emburrassment appear the cold precordial coil is indicated High fever is controlled by wet packs

# CONSTITUTIONAL AND METABOLIC DISEASES

Anemia-Chlorosis -- To prevent heat abstraction while obtaining encrectic stimulation of the nervous system is the hydrotherapeutic aim in treatment of chlorosis To lessen the heat loss all cold applications should follow some heat retaining measure, such as the warm bath at 100 F, with room temperature not below 70 F the dry pack or. without increasing the heat by additional measures the heat retention during the period of sleep mix be utilized by applying the invigorating procedures upon arising in the morning

The choice of the innervating measures is great Abbitions of 80 F which are lowered two or three degrees dails and combined with mechanical stimulation rapidly given in the warm bath frequently give bappy results The ablution may all o follow the drs pack. Wet packs followed by the half bath and rain baths are valuable auxiliaries when the nerve tone has been heightened. Circular and spray douches of two to thirty seconds' duration with water, first of high temperature %. F. and then reduced to a temperature as low as 45 F followed by massage yield excellent results Hot air baths of 125° F to 160 F should prerede the

n s of the douches

The following plan of treatment is valuable. Electric light baths for fifteen to twenty punutes then the fan douche at 10. F with twenty pounds pressure for thirty seconds and then at 70 F for infreen seconds and a dry rub followed by one hour of re t This treatment is repeated on alternate days

Secondary Inemia - The general treatment is that prescribed for chlorosis Among the special manifestations of the pancity of the blood cells the cephalalgia, and the coldness of the extrematies-particularly the feet-may require special measures. The beadache responds bappily to the use of a hot water coil applied to the neck and the cold rab con haed to the legs Brief running toot baths are the most efficient measure to relieve the coldness of the feet Cold douches u ed after a preliminary hot application are indicated in anemia of the viscera. They may be general, as the Scotch douche or localized as the fan douche applied to the abdomen

Diabetes Insipidus-Warm or cold half laths and full baths are recommended. The half baths possess a special value for neurotic ehildren

Diabetes Mellitus-In addition to attaining a strict cutaneous hy giene thus obvisting the dangers of cutaneous complications by drotherapy everences ome remedial power over diabetes, especially that form which Acute Bronchitis—A wet pack for two hours, followed by mechanical stimulation, should be tried in an attempt to terminate the disea e stimulation, should be tried in an attempt to terminate the disea e stimulation, errors pick (Priessnitz) at a temperature of 45° to 5° F, renewed every two hours, often lessens the cough and exerts an analgest effect. The I issueer method of spraying may be employed for its expectorant influence after rapid apphention of a steam spray it 110° to 125° F, for fifteen seconds, over the upper part of the truth, a cold fan douche is applied for three to five seconds, a rapid friction rub follows. In sixteen cases in which this routine was employed I issueer obtained ready expectoration. The cold Leiter coil to the precordium may be needed, particularly in the aged. Hot mustard foot baths are of proventable.

Acute pulmonary affections frequently complicate the exanthemata, particularly measles When in their course, bronchitis or bronchopnen monia appears, cold half baths for five minutes at 78 8° to 71 6° F, with douching and subsequent gentle mechanical manipulations, are indicated I stremely brief plunges into water at 61° to 54° F, succeeded by strong friction, may be used if the case is doing badly. The mustard pack as practiced by Herzfeld is very efficient. In this measure flannel applica tions are made of one to ten or twenty dilution of oil of mustard which has been made according to the directions of the German Pharmacopean The diluent is equal parts of alcohol and water and the degree of dilution depends on the urgency of the case The application envelops the child from the neck to the knees and remains in place until the skin is mark edly hyperenuc. When the desired cutaneous hyperenua is attained, usually in from fifteen to thirty minutes, the child is placed in a wet, 33 per cent alcohol pack At the expiration of one-half hour the wet pack is supplanted by a dry sheet. This procedure should be repeated every twenty four hours and oftener if the case is very severe. It produces its happy results very rapidly

Edema of the Lung —The mustard pack is claimed to be quite efficient in pulmonary edema The application is continued thirty minutes

Hyperemia of the Lung — The hot bath at 106° to 110 F for tea minutes, or the hot bith for five minutes followed by a warm pack, is the usual remedial measure employed. The hot mustard foot bath is of value to induce sweating

Pleurisy.—In acute plcurisy three symptoms are present, cough, drapnea and pun, which are amenable to hydriatric treatment. The cross binder through which passes a cold water coil is the most efficient measure. The ree by may be used. Wet packs and mechanical stimulation, and half baths, 71.6° to 68° F, are valuable auxiliaries. In event of an effision steam baths or hot air haths, lasting ten to fifteen seconds, followed by mytograting measures are employed to induce dryphoresis.

The two-hourly changed cross binder may and absorption of an effusion.

Should

follows their termination. Some advocate the application of heat only to a degree necessary to obtain visible perspiration

Podagra -When gout is found in association with obe ity the hydri atric management laid down for that disorder should be installed at once In the more scute forms analyssia with minimization of the articular and periarticular efficients may be obtained by the use of brief cold applications to the affected parts. These may be followed by circular cold compresses To combit the more chrome gout the following treatment may be employed A jet douche of 104 F under fourteen to eighteen pounds pressure is followed by a full both at 100 to 104 I patient is then placed in a dry blanket pack for ten to twenty minutes and then given a cool douche A rapidly administered alcohol rub ends the treatment The indirect douche at a temperature of 98 to 104 F applied under a force of fifteen pounds in a warm bith is all o employed Wet packs applied from one to two hours, with a subsequent brief cold douche, such as the rain douche, are of value General disphoretic meas ures such as the hot air bath until perspiration is visible tollowed by gradually lowered pressure douches are warmly endor ed The success which the spa treatment of gout has met seems to rest in part upon the severe hygiene there imposed upon the patients as the hydriatric values of the various waters seem no greater than that employed in the hos pitals and sanitaria

Chrome Articular Rheumatism—If in good condition the patient should be placed in the hot air cabinet for ten to fifteen minutes after which the jet douche should be applied at thirty pounds pressure if the tenderness is not extreme. The hot air water douche at 110 to 11.0° F, and tho cold douche at 80 F alternating with one another for fifteen and thirty second periods of application respectively until three or four munities have elapsed, are utilized. Another form of routine treatment is as follows. The patient receives a brisk rubbing while in the full bath of 102 to 104 F which is continued eight to ten minutes. Upon leaving the bath he is placed in a hot div blanket pack, in which he remains eight to twelve minutes. A five minute alcohol rub concludes the procedure. Later a hot douche 103 to 104° F, may be given before the bath. It should not be applied to the head. Massage and a cool douche may be employed affer the bath.

Steam baths and wet packs may be of value. They should be followed by low temperature applications as cold rubs or three to fit-centimate coid half baths. The Scotch double and circular compresses applied locally are most valuable. It is possible by these various procedures to improve the circulation of the affected parts: suce absorption of efficiency and increase the mobility of the discassed joints. Atrophy of the surrounding muscles may be combitted by missage or by the use of a very brief cold shower bath to the part in question. Fanduration of the joints for a

accompanies obesity Powerful stimulating measures are employed and are often preceded by the application of licat. All efforts should be concentrated upon the attainment of a vigorous reaction. Improved general metabolism and lessened tendency to acidosis are among the beneficial results obtained by the use of water.

The hot air or electric light baths for five to ten minutes, next the circular douche, 105° F, for thirty, seconds, then continued at 90° F for thirty, seconds, then continued at 90° F for thirty, seconds, and then the jet and fan douche to the entire body, 70° F, for twinty seconds, may be employed once every twenty four hours. The temperature of the final water should be gradnully reduced until 60° F is reached, and the jet douche pressure should be progressively increased until twenty or thirty pounds is attained. Ten minute half baths at 85° F with vigorous mechanical stimulation while in the tub, precede by wet packs, may be used. The pecks should be continued about fory five minutes, and should be, when applied, about 50° F. Brid cold places and the dripping sheets accompanied by friction may be employed at home.

Exophthalmic Gotter—Applications of cold either the I enter coll or ice-bags, to the thiroid gland and the precordinm stree to slow the best. Occasionable in ice rnb may be needed. Wet pieks for the period of one hour, combined with the cold Leiter coll to the spine and followed by a helf bath, 70° to 75° F, will ometimes allay the tremor and

palpitation

Obesity -The attempt of hydrotherspentic measures in treatment of obesity is to increase general metabolism and thereby promote oxidation In the presence of fatty myocardial changes the more severe applications should be made with eaution, or with a cold precordial coil Diaphoresis by means of hot air baths, electric light baths, steam baths, full hot baths, and packs, of ten to forty minutes' duration, should be induced Then cold applications in the form of half or full biths, douches, and ruls at between 55° F and 70° I, should be employed Frequently an a cohol rub concludes the treatment Hunsdale finds the combination of full hot bath and pack superior to that of hot air bath and douches, and cites two hundred and sixteen cases in which this combination was used Of these cases one hundred and sixty eight gained weight Together with a strict distary regime and hydro intervention, muscular exercises should be rigidly enforced Physiolo, ically unfamiliar exercises are the move While each case presents peculiarities necessarily en ments of choice tailing modifications in the treatment the following prescription from Hinsdale may be followed as a guide A full hot bath at 104° F for twelve to eighteen minutes during the first three days. A hot dry pack is then applied for the same length of time A cool spray, about 75° F, and an alcohol rub are the final applications After a short rest of twenty minutes long walking exercises are instituted, and massage for one hour

is mainly diaphoretic. This is purticularly true in the cases of interstitial nephritis As a rule, the diaphoresis is more rigorous than in acute nephritis Hot and cold applications are employed Of the former one may select the hot bath, the sterm bath the hot air bath, or the electric-light bath. Dry heat is less effective than moist. If there be pronounced sclerotic changes in the arteries the baths must be given cau tion ly The application of the cold Letter coil to the precordium will quiet the heart during the period of thermic excitation and guard against cardiac weakness The electric light bath, in thirty minute applications followed by a blanket mek, has given excellent results in penhritis with edema

The following measures may be employed in the order given. The electric light bath for ten minutes followed by a circular douche at 102° to 106° F at twelve to filteen pounds pressure, for thirty to forts seconds, then the jet douche at the same temperature and pressure applied for thirty to forty seconds innelly vigorous dry friction Baths at 95 to 100 F may be used in subscute cases. All these hydro therapentic measures must be combined with dietetic treatment, especially restriction of fluids

If the rigid vessels can withstand the initial stimulation caused by the shock of cold applications the cold douche, the cold rub cold baths and the cold pack may be used Continuous packs at 70 F over the loins and abdomen, changed every five hours coupled with baths at the same temperature are highly recommended

The effect of hydriatric applications is to increase the percentage of uriuary solids. This increase may persist for several days after the application. The cold measures are most effective in augmenting the volume

of the urme

Uremia -Hot wet packs applied for thirty minute intervals every four hours and vapor baths given by covering hot bricks with wet cloths continued for an hour are employed Carcful enteroclass with water at a temperature of 110° to 120° F may be tried when all else faile belamptic manifestations sometimes yield to the wet pick at 70° F applied for one hour Alcohol sweet baths are of value The withdrawal of blood up to one liter should not be delayed. If it be possible to obtain a strong reaction, cold in the form of half baths at 68° to 71 6 F or cold wet packs at 70 F are utilized

Prostate and Urethra-Acute Conorrhea -Local thermic applicamersion in water at a temperature of 10. to 115 F for ten to fifteen initiates three or four times a day. I ocal cold measures are also endorsed

Gonorrheal Arthretis - See Joint Affections

Prostatitis - Continuous irrigation as described under cystitis pos sesses special value in relieving pro tatic diseases. The water used in short time, ten to fifteen minutes, enables the patient to withstand greater mechanical stimulation

Muscular Rheumatism—The most common varieties of mucelly remains are lumbyog, pleundynn, and torticollis For these bot dypecks, with moderate mechanical simulation, may be employed with happy results. Baruch recommends the use of the hot air cabinet for five to fifteen minutes, followed by the presente jet douche. The presente should be thirty pounds inless much tenderness be present. Should be condition tend toward chromesty, alternating temperature applications will prove of value.

### DISEASES OF GENITO URINARY SYSTEM

Bladder—Cystitis—Inflammatory processes of the bladder may be treated by prolonged baths and arrigation. The bath is usually given at temperature of 100° F, and is continued for eight hours daily. While the bath is given the bladder is continuously irrigited. Hunner reports six cases of bladder disease as favorably influenced by this treatment warm sitz baths, 90° to 90° F, for thirt to sixt minutes, are recommended. The bammock bath at 95° to 100° F applied hours duly for a long period of time, even months, often affords relief. However, the inconvenience and the trouble involved are hardly report by the results

Nocturnal Enuresis - Affusions at 60° \( \text{F} \) and the half bath are recommended Cold rubs and cold plunges at 60° \( \text{to 60° V} \) and to 644° \( \text{F} \) are of value to affect restoration of the lost sphineter tone. If these measures

are not fruitful, the short cold sitz bath may be tried Kidneys -- 1cute Nephritis -- Gentle diaphoretic measures are indi cated in acute nephritis Moderate sweating can be accured by the use of hot baths, 100° to 108° F, lasting from fifteen to thirty minutes The effect of the baths is prolonged by the use of a dry blanket pack after the bath Moderate draphoresis is highly desirable, as it places less strain on the heart and lessens the dunger of uremin due to sudden elimination of a large portion of the liquid portion of the blood Such treatment is hased upon the assumption that the skin may partly assume the rend excretory role This view is not entertained by many noted scientists, who claim the exerctory function of the skin is so slight as to be practi cally negligible It may be that the warm baths increase the town destruction or its modification or its elimination by the kidney and bowel For the nephritis of febrile diseases, particularly that of scarlatina in infants and in the extremely young the warm both, 100° to 101° F is used, for older children full tub baths at 90° to 100° F, with the child in a blanket, render best service Half baths at 73 to 77° F combined with strong dry rubs are recommended

Chronic Nephritis -The treatment of chronic nephritic conditions

is mainly disphoretic. This is particularly true in the cases of intersitial neplicitis. As rule the disphoresis is more rigorous than in acute
nephritis. Hot and cold applications are employed. Of the former
one may select the hot bith, the ste-un bith the hot air bath or the
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viriliae weakness. The electric-light bath, in thirty minute applications
followed by a blanket pick, has given excellent results in nephritis with
elema.

The following measures may be employed in the order given. The electric light bath for ten minutes, followed by a circular douche at 102 to 100 F at twelve to fifteen pounds pressure, for thirty to forty seconds, then the jut douche at the same temperature and pressure applied for thirty to forty seconds finally vigorous dry friction. Batha at 0.5 to 100° F may be used in subacute cases. All these hydro therapeutic measures must be combined with dietetic treatment especially extinction of fluids.

If the rigid ressels can withstand the initial stimulation caused by the shock of cold applications the cold douche, the cold rub cold baths and the cold pack may be used Continuous packs at 70° F over the loius and abdomen chan.ed every five hours, compled with baths at the

same temperature are highly recommended.

The effect of hydriatric applications is to increase the percentage of urinary solids. This increase may persist for several days after the ap

urnary solids. This increase may persist for several dive after the application. The cold measures are most effective in augmenting the volume of the urne.

Uremto—Hot wet packs applied for thirty minute intervals every

four hours, and vapor baths, given by covering hot bricks with wet cloths continued for an hour are employed. Careful enteroolysis with water at a temperature of 110° to 120° F may be tried when all else fails belamptic munifestations ometimes yield to the wet pick at 70° F applied for one hour. Alcohol sweet baths are of value. The withdrawal of blood up to one liter should not be delayed. If it be possible to obtain a stron, reaction cold in the form of half baths at 65° to 71° F or cold wet packs at 70° F are withzed.

Prostate and Urethra—icute Gonorrhea—Local thermic applications are recommended in gonorrhea. The usual form employed is immersion in water at a temperature of 105 to 115° F for ten to fifteen minimizes three or four times a day Local cold measures are also endorsed.

Gonorrheal irthritis - See Joint Affections

Prostatitis—Continuous irrigation, as described under cystitis pos sesses special value in relieving prostatic diseases. The water used in the acute form may be cold, that is, at a temperature of 50° to 53 6° F. Care must be exercised to avoid increasing vesical irritation, which is often present. Chordee may be greatly reheated by the hot dip both

Salpinx uterine ovarian—Imenorrhea—Aminorrhea—is usually accompanied by a relatively seemty blood supply to the uterus. He correction is usually achieved by hot local applications. Hot site baths at a temperature of 110° to 114° F, listing ten to thirty immutes, and the lot viginal double at 100° to 110° F, are the measures most often uthred that full baths may be pressed into service. The benefits accruing from the employment of these procedures may be increased by general massage in all cases, and in a few specially indicated cases by the kneading of the pelvic tissues.

Later, measures to increase the systemic tone may be adopted.

Dysmenorrhea —If spism of the uterus is found accompanying pain ful menstruction, not applications are efficacious. The of choice in the tot site both before returng hot double and hot compresses. The rare of temperature should be from 108° to 116° F. Acubem buths are recommended by Baudler. If the dysmenorrhea is due to faulty nerrous mechanism, general measures should be instituted to reastable he the normal function.

Chronic Endometritis—To men use the vascular tone and remore the excess of blood a vaginal douche at 108° to 115° F should be given both upon arising and just privious to returing. One to two and a half gallons of water should be used to which enough salt should be added to determine a physiological saline solution. Excellent results are uclided by the Nauhelent retainment if but little connective tissue overgrowth has occurred. Short cold sitz baths at 85° I' may be tried. During estation however, the hydritire measures should be employed with extreme caution.

Menorrhagia —Of the local applications designed to lessen profuse menstruation, the long-continued vagural irrigation at a temperature of 120° F produces excellent results. In addition general and local measures should be directed a nurst the causal factor.

Chronic Vetritis—This is rivil found except as an accompanion of endometritis. Nanheim baths are recommended for those forms due to incomplete involution and inflummation. In general, the treatment is similar to that of endown truts.

Acute Salpingitis—The severe pelvie pain usually present may be modified considerably by prolonged vaginal irrigation. Two to three gallons of normal salt solution at 110° to 190° F should be used three times daily. Hot abdominal compresses are valuable adjuncts. If see r. puin yields not to these measures the ice-bag may be tried. Should the condition become chronic, the Nauhem bith will evert a distrible solution are effect upon the pelvic circulation.

Testicle—I pididymitis and Orchitis—Thick compres is wet in a siturated solution of magnesium sulphate at 60 T renewed every half to oue hour, lessen the pain and promote absorption of the inflammators exudate

# DISEASES OF GASTRO INTESTIVAL TRACT

Bhary hepatice—Cholelthews.—The cluef value of the hydrature arms in the treatment of gall stones is the relief of the paroxysmal pain of the bility colic. Warm applications render the greatest service. The hot bath pack is highly recommended. This is upplied is follows. The patient is placed in a buthint and covered with water at 104. F. which is gradually increased to 115. F. The cuttre, both has a duration of five to ten minutes. When the both is concluded, the printer is wrapped in a hot sheet and blankets and allowed to remain for thirty minutes to an hour. Then an alcohol rub or affusions at 00. F are given. Hot witer may be given by mouth and gastrie lavage may be employed. The latter his proved effective in obstinate cases. The trunk compress with the hot coil often arvise rules?

Hepitic Hyperenia — Duly cold itz biths at 46 4 to .0 F con tinued for five to ten minutes and cold shower bithis combined with cold move bid find doubles to the shin over the liver often succeed in diverting the blood supply to the superficial tissue. The venous stagnation so frequently found in the liver is usually a manifestition of circline or pulmonary trouble and is relieved by measures directed toward the importance of the heart and lunes

Enterio Diseases—Conditation—Constitution using in the idence of organic disease is reduced to in items or system condition of the intestinal musculature. It is of highest importance to distinguish between these two forms as the hydrotherspeutic management of each is radically different.

In the atomic form general mea ures to invigorate and tone the faulty muscle should be employed. In patients of good physique cold may be applied at once as a compress or donder. In the les heroic warmth to the point of perspiration is required prior to the administration of the cold applications. For atom one may proceed by applying the hot air lyth or electric-light bath until moderate disphoresis is induced. This is followed by the circular douches at 95° to 10.9° T under fifteen to twenty pounds pressure for one innumber. The Stooth douche with one-quarter inch mozele and fifteen to twenty pound prissure, is applied over the colon at 60° and 112° F for fifteen-second interval. A fundanch at 7° F and tacuts pounds pressure for the socious to the lack, abdomen and che t and massage to the abdomen with particular, application to the colon, end the preserption. An open air walk

augments the effects of the treatment Irrigations of cold water at 644° to 710° F, beginning with small amounts and later increasing to one quart are of value The cold rub, followed by a brief cold sitz bath of not over five minutes in duration, everts a particularly bappy effect upon the enterior neuromuscular mechanism

The spirito variety of contineness requires relaxation measures. Warm or hot applications are more efficacious than is cold in effecting the desired relaxation and sedation. Warm or hot sit baths at 104° to 110° F for twenty minutes, hot compresses to the abdomen, brief warm douches, and irrigation of water at 104° F are the measures of choice Carefully graduated cold enemata administered upon awakening have been added to the following the continuous continuous and control of the continuous continuous

Diarrhea —If purging he due to dietetic errors, the removal of the irritant material is imperative. This can be accomplished by odd hip biths, 50° to 64° I', applied from one to five minutes. Irrigations are also of service. Should undue peristaltic activity be the cause of the diarrhea, hot sitz baths at 100° F given from thirty minutes to one hour, the hot coil placed over the stomach in conjunction with a wet compress, and half baths at 100° F are the indicated measures. The symptomate diarrhea of caturrhal inflammation of the intestine disappears when the hyperemia, hypersecretion, and hypermothity are reduced to normal This reduction may be realized by the intervention of moderately prolonged cold measures.

One routine plan is a cold rub, followed, without drying the skin, by a sits both at 50° F, for ten to thirty minutes. The abdomin receives a strong rubbing during the sit lath. When the bath is ended an abdominal binder is put in place and replaced when quite dry. Another prescription begins with the hot air bath until the skin is hyperemic flus is followed by a wit sheet rub and a simultaneous hip bath at 70° F, and a foot both at 110° F, for ten minutes. This may be given daily with gradual decreuse in temperature of the hip bath to 50° F. The hammock bath at 55° to 100° F often has a benign influence.

leute Lateritis—After the contents of the intestines have been et pelled, the severe pain and the diarrhea may be lessened by hot applied tions. Should chronicity develop, the half bath at 70° F reenforced by the repeated pail pour seems favorably to influence the course of the disease.

Acute Appendicties—The use of cold, as a cold coil, the ree-bag or an nee poultice, prior to operative interference lessens pain, emesis, and singultus. Gauze should intervene between the skin and the ree to miniture the danger of gangreene.

General Diffuse Peritoritis —The treatment here is identical with that of appendicatis Should proctoclysis be adopted, it should be very centle

Gastre Diseases—itony of 'tomach—Brief cold upplications en hanced by kneading the abdomen partially restore the lost tone and im prove the singgish circultion. The cold rub followed by a short cold hip bath may be used. The hot air bath or warm bath to induce visible sacating by a jet or fan donehe at 60 F, applied to the abdomen for ten to thirty seconds, is productive of benefit.

Acute Gastric Catarrh.—Hyperemests yields as a rule to nee water or nee. The abdominal binder renewed every three or four hours may be employed. If high fever arises general heat reducing measures are indicated.

Chronic Gastritis.—If atony and dilatition of the atomach are associated with this disease they should be combated by the appropriate means use. The gastritis is treated by the half bith at 70. It concluded by the pail pour repeated several times. Lavage often renders sturdy service in ridding the stomach of these tenescous mueus. General insignating treatment should be instituted. A cold rub upon arising, with subsequent it gorous mechanical stimulation and evertise, is followed by the jet end fan doucho at 80 F. This temperature may be gradually lowered in the later applications which should occur once every twenty four hours. This treatment his proved eyer effectent.

Gastroptosis — After a hot bath at 10. F for five minutes, late in the formoon a spinal douther at 100 to 102. F of twenty pounds pressure is applied for ten seconds. Then the pittent returns to bed and the abdomen, particularly the epigastrium is well covered by a hot wet fian nel compre s, which is he ited by an electric pud and renewed two bourly. An elastic bunder tightly encases all. This prescription is recommended.

by Lockwood

Dilatation of the Stomach —This morbid state is usually found in conjunction with atony and its treatment is practically that of atony lavage of the intertines and irrigation possess special value in this disorder

Arrivat Dyspepsia — The hot air bath at 160 to 170 F for six minutes, succeeded by a five-minute friction tob bath at 95 F then by the rain diordie of twenty pounds pres are at 95 F gradually lowered to 90 F and then by the sprix douche at 80 F for five seconds followed by mechanical stimulation has given excellent results in the hands of Barnet. The jet and fan douches may be used with the temperature daily decreased

Cold sitz baths at 50° to 60° F lasting from three to eight minutes, cold sheet rubs at 53° to 64. F upon arising and brief cold shower baths are of service. The malady is very resistant to treatment.

Ulter of the Stomath—To promote a greater blood supply to the stomach is one of the initial remedial steps in treatment of ulter. The cold sitz both at \$00\circ\$ to 54\circ\$ F for three to five minutes and trunk com

presses combined with a brief appliention of the hot coul to the abdomin serve further to meriuse the blood flow. In mildition, the last measure mercases the alkalimity of the blood (Buxbamm) Cold compreses to the stomach are of service. To control hemorrhage one may place see water or 100 in the rectum and apply the cold stomach coil. The latter series more efficiently when combined with the cold stomach compress. A street dictury regime must be used in communition with the hydristric measures

Is gustric inleg frequently occurs in chlorotics, prophylicise treat ment should be instituted in all cases of chlorosis. Cold sitz biths at 46° to 57° I , for three to five minutes duly, abdominal packs renewed every three hours, with a fifteen minute application of the abdominal coil at 104° I once a day, are the measures often employed A coll pack for twenty to thirty mimutes, followed by half bith at 70° I for two minutes, is of value. The pain is relieved by the application of the electric pad to the engastrium

## SLECTIC INTLATIOUS DISEASES

Although control of the body temperature is the cardinal ann of hydrotherapeutic measures in the treatment of acute febrile discusother manifestations of the toximu-the rapid heart, the lessened blood flow, the quickened shallow respiration, and the emesis-are as cognatin their claims as the fever The altered metabolism as indicated by the mercise in the urmary ammonia, natrogen, and the deere ise in the nires nitropen, the lessened alkalinity of the blood, and the alteration of the morphological elements of the circulatory fluids also claim atten Hydristric measures are able to exert a beneficial influence upon all these abnormal expressions. The applications in vogue are the pirtial abhition, the half bath, the full bath, the continuous bath, the hammock both, the Brand both the wet pack, the cold rub, the trunk compress and cold applications over the precordium and to the head

Diphtheria - The wet pick changed at uniform intervals with the final application continued until visible perspiration appears, and then followed by a bith at 75° to 82° I', combined with vigorous afficients, yields happy results. Ico finely subdivided applied in bags to the throit

often modifies the disease

Influenza - Hot boths are recommended. Sheet boths may be effect

tual in increasing the systemic tone

Exanthemata-Measles -I ull boths at 103° to 107° I , listing from three to six minutes, according to the age of the child, given five or it times duly, have met with wonderful success according to their spensor, Dr Grosse As the disease is developing, boths at 95° to 100° I are frequently employed Many mercly sponge with cold water, especially if there be hyperpyrexia Brief plunges into water at 55° to 60° F often influence the extreme cases Pulmonary complications are considered later

Scarlatina -The remedual value of hydrotherapy in scarlet fever is manifest in the decreased death rate, the low percentage of complications, and the lessened period of infectivity of the disease. The applications may be either hot or cold Warm or tepid sponging as applied twice duly in ordinary ca es The warm bath at 90 to 98° F given once in twenty four hours is also effectual in cases of moderate severity. In desperate cases boths at 90 F of five to ten minutes duration, repeated every four hours, are very efficient in alleviating the symptoms. Han som cites three characteristic cases in which these applications were of demonstrable value. The hot bath at 98 to 104 F or hot air bath is employed to relieve anuresis Dr. packs may be subsequently applied Although a temperature of 103 F is the indication for the application of cold, undue depression tachycardia and insomnia also demind it. The Kerley graduated cool pack made of Turkish toweling applied to the torse and kept in place until the temperature is 102 F, is a valuable mersure The initial temperature is 10 F by reductions of five degrees every five minutes 40 F is reached at which figure the temperature is kept thirty minutes. At the expiration of that time if the fever is not perceptibly diminished the temperature of the pack is re duced to 70 F or 00 F Partial ablutions at 72° to 80 F of a duration dependent upon the readiness of the receive response may be employed. In the early stages affusions at .0 to 70 F following five to ten minute full bath at 100 F often relieve an embarras ed heart The pyrevia may be reduced by graduated ablutions which are instituted with a temperature of 90 F and with each administration reduced one degree until 75° I' is reached. The wet pack may be employed. In a series of one hundred and ten ea es treated by cool applications not one case of nephritis developed. Angina and adentits are treated by cold compresses

Syphils—Some increase in climination of toxic materials is call ed by the displorers induced in the stein reduced both. Sweeting may be also provided by the dry prek. The i processes effer no interference to the entancous absorption of increary. On the contrary, they seem to the entancous absorption of mercary. On the contrary, they seem to calmane it. General simulating measures are employed to increase the systemic vigor and off of the general effect of the circulating poison. Of the chief the chief chief they proceeding the one-way, should not extend over pack is quite effective. This procedure however, should not extend over five days. The beneficial results obtained at such spits as Mt. Clemens and Hot Springs depend more, upon the strict increarial treatment administered than upon the chemical properties of the various waters used in bithin. The value of the bith lies in the extreme cleansin, of the epidermus which leads naturally to a more rupid and thorough absorp-

tion of the mercury It is claimed that the waters of Aixles Bains, by the virtue of their calcium sulphid content, exert, when applied externally and internally, a partial curative effect in lies

Tetanus—The application of heat vields the hetter results, although cold measures have been the more employed. Of the warm applications the bot wet pick of 100° to 110° I and the warm hath are most effective Combined with untitetance serum, they help to oppose the advance of the disease.

Pulmonary Tuberculosis—Prophylactic treatment of tuberculosis of fords a valuable field for the practice of hydrotherapy. The estables ment of thorough prophylaxs is sometimes designated "hardening" lisshould be commenced early in those suspected of a tubercular predisposition. It is instituted by gradually lowering the morning both to 86°F. The hath should seldom exceed ten menutes in duration, and when ended a cold affusion of 70°F should be given, and then brisk friction applied Older children may be immersed in water at 80°F for one to four minutes, and rubbled vigorously while in the bath. Undue heat loss is availed by making the application in the morning. Exposure to singlest and artificial or natural sea bathing often serve to increase the general resistance.

When the disease has developed, cold sponging with ordinary top water, practiced each morning, is valuable. Poor circulation is a contra indication to this procedure. The chest compress and the cross inder applied for long periods of time are useful remedial adjuncts in controlling pain, faulty respiration, expectoration, and cough. Ther also exert a favorable influence on the course of the disease, stimuliting the encapsulation of infective foci and enhancing the absorption of essents or necrotic tissue. This is probably due to increased pulmonary blood flow.

The Cornet method of hydriatric routine may be employed. The patent receives, at first, simple friction morning and night, intil a strong reaction appears. After one week of this, firstion is made with a club wet with water at a temperature of 92° F. This temperature is gradually decreased to 66° F in the course of several treatments. One-half hour of rest is enforced at the end of the treatment. If this treatment has been tolerated well, two-minute rubs in a sheet wet with 5 per certainly appeared to the send of the treatment of the seal and solution, at 90° F, are injugated. The brine is made more cold each day until 60° F is reached. An open air walk for one hour follows the treatment. Douches at 90° to 95° F may be used, except when copious expectoration or increased nervous excitability is pre ent. It is possible so to adapt patients to cold measures that they take douches of tap water it a temperature of 40° F during the winter, and appriantly suffer no inconvenience. Another method consists in beginning fullutions at moderate temperature, 95° F, and gradually reducing the

temperature daily, until 60° F is reached. Then the ablution is supplanted by an effusion at 90° F which in turn pa ses through the descending steps until 50° F is obtained. The affusion is practiced daily Four basins full of water are used at each treatment.

In the presence of fever all violent measures are contra indicated. The cool sponge bath usually controls the fever but if it fails, ice rubs should be tried. Hemorrhage is met by ice-hags or the cold Leiter coil.

to the thorax and the thighs

Yellow Fever — Draphoresis by means of the blanket pack should be induced. In the beginning of the disease hot foot boths at 105 to 110° F

may be tried

Anatic Cholera—A cold rub in a heet completely or partly wring from water at 45 to 50 F or a hall buth for two to five minutes at 68 to 80 F, often prevents the appearance of duarrhea Early enteroclysis with warm water often reheave the spassm of the interior. A cold ruh in a sheet at 32 F, followed by a sitz bath at 5 to 12 F for fifteen to thirty minutes may check purging and favorably influence comiting. Ice-cooled water applied as rubs and sitz baths is indicated when the disease is very scores.

Cholera Infantum—Cold haths are not advable. The happiest results follow tho use of haths 9x to 100 F given frequently for intervals of five to ten minutes. The addition of mastard to the hath will enhance the benefits ageruing therefrom. Care must be taken however, to protect the eves from the irritation of the mustard and also from the infective agent of the disease. If consulsions appear or collapse or low temperature ensue, heat either h this hot bath or incubator or both eom hined, abouild be at once applied. The following methods taken from Budin Misloney will prove of use to combat collapse convulsion, and low temperature.

'Two methods of giving the bot bith may be followed. In one, the infant having let us say 1 rectil temperature of 83 2  $\Gamma$  as plunged into witer at 1004  $\Gamma$  and left there fifteen to twenty minutes. The rectal temperature is then found to rue to progressively  $0_c^3$ ,  $0.68^2$  to 9.68 a, and  $9.0^2$   $\Gamma$ . The infant is then taken out of the bath and placed in an inculator, and the rectal temperature taken several times to find the duration of the action of the hot water.

In the other form of administration the infant is immersed and deally in water which has a temperature one degree higher than that of the body, 9. F in this sease. The temperature of the water is sten gently increased until it reaches 100 4° F while the temperature of the infant gradually rises to 99. F affire twenty immutes it is placed in an inculator It is found that the temperature in the latter case remains nearer the normal and falls above than in the former.

Dysentery—The form of this disease caused by amelia invasion of the intestine is treated successfully by cold enteroclysis with water at 40° F or even ince-old. The find should be administered gently in order to obtain pain. Ice suppositories may be tried in the bacillar variety. The careful introduction of warm saline solution into the color after defection is effective in controlling pain and diarrhea.

Typhoid Fever -The best results of hydrotherapeutic management of enteric fever are obtained when the treatment is instituted at the caset of the disease As a rule, the cold applications are employed, and of these the Brand bath enjoys most favor While with some authorities it has been partly supplanted by less berote measures, accumulated statistical evidence attests its efficiency. It is given as follows. A portable tuh is placed by the bed and two thirds filled with water at 70° F 4n ounce of wino or a spoonful of alcohol is given twenty to thirty minutes before the bath, or four ounces of hot coffee may be administered just be fore immersion. After wetting the face with ice water, the patient is placed in the tub and the entire cutaneous surface mechanically stim ulated by a sponge Tho unitral shock and the feeling of coldness u nally mete desire in the patient to quit the bath, but in absence of symptoms of collapse or marked shivering, immersion should continue for fifteen minutes Twice during the bath one half gallon of water at 50° F should be poured over the shoulders and head. A slow pulle of small volume does not indicate withdrawal from the bath At the expiration of fif teen minutes the patient is wrapped in a sheet and blanket, placed on the bed and, if his temperature exceeded 10.5° F, evaporation is per mitted in order to increase heat loss. If shivering be extreme the skin is dried and he is returned at once to bed. Artificial heat is undesirable, but may be needed to insure reaction, although vigorous rubbing and curtailing the length of the next bath are superior methods of furthering the reactive powers Four to say ounces of ee water are given twenty to thirty minutes after the hath, and an abdominal compress at 00 F, renewable hourly, is applied. The bath is repeated every three hours or oftener if indicated. A temperature exceeding 103 5 F, a low mut tering delirium, extreme muscular twitching insomnia, and other mani festations of toxemia demand immediate bathing. The total number of baths is variable as many as one hundred and seventy five have been given to one patient The wonderful results of the Braud bath are shown by the 50 per cent reduction of mortality from typhoid recorded by Dr Thompson from New York hospitals In Australia, of nineteen hun dred and twenty three cases so treated, only 7 per cent died (Hare)

Various modifications of the Brand bath have been offered Affusions at 70 F, gradually lowered to 60 F, are endorsed by Cabot The hammock bath at 88° F, in which the patient is kept until the tempera ture taken per rectum is 100° F, whereupon the hath is omitted for two

hours or until the temperature, again mounts to 10.25° F seems to be nearly as efficacions as the cold bath. The cold buth may be abbreviated from cight to five minutes and employed every three hours when a poor reaction results. As the recaperative powers increase, the duration of the buth is prolonged to fifteen minutes. The partial abbitton is used also to test the reaction. The cineral effect of these modified baths is not equal to that of the original measure.

As mentioned above some medical man regard the cold bath as too severe, and have devised substitute entailing less distress to the patient The ice rub, which is the stron, application of a flat piece of ice to all of the body except head and neck exposin, only the part worked mon at a time, is warmly endorsed by Harc A tall of two degrees in tem perature and a slowing of the heart usually result from ice rubs spong ing with cold water is claimed to be effective in cases in which the tem perature is not over 101 to 103 F The graduated both beginning at 95° F and closure at 80 F is employed Full warm baths at 88 F shortened the course of the drease and reduced the mortality from 10 to 8 5 per cent, according to Riess who has employed this measure in eight hundred and nine cases A temperature of 102 F requires the tub for five to ten hours until the rectal temperature is 100 F It seems how ever, the substitutes fail to e mal in etheacy the Brand bath. The sta tistics concerning these modifications are incomplete but yet they indicate a higher death rate than follows the use of the Braud method

Hemorrhage is met by re t and cold abdominal applications. Ice

may be used with due precentions against gangrene

Malara — All applications should autorpate the purovsm for once the chill begins it cannot be checked. Abortive treatment is efficient. You could double at 60 F under twenty to thirty pointed pressure to the back for five minutes with a simultaneous bot foot bith has proved a subtible routine prescription. Cold hip biths and cold doubles have cured malaria of several years standing after arsenic and quanti had failed. Two hundred and sevent two reported cases have yielded to hydrotherapy alone. The following prescription is effective. A hot air bath is given for five to ten minutes about one hour before the chill lath is given for five to ten minutes about one hour before the chill lath is given for five to ten minutes about one hour before the chill lath is given for five to ten minute. The donche hould be used at a pressure of from twenty to thirty pounds. While the double is applied a hot foot leth at 100 F is should be given. The can's le prescribed again in one-half an hour and two applications preceding the chill are usually able to pravent its uppersance. Should a caure appear a wet pack at 6.0° F is useful in reducing the temperature and promoting elimination.

Cerebrospinal Meningitis —Cold applications and as the recebig or Leiter coil to the head and back of the neck are indicated. Hot baths at Dysentery—The form of this disease caused by unche invasion of the intestine is treated successfully by cold entercolysis with water at 40° F or even use-cold. The find should be administered gently in order to obtain pain. Ice suppositories may be tried in the buellar variet. The careful introduction of warm saline solution into the color after defection is effective in controlling rain and diarrhea.

Typhoid Fever - The lest results of hydrotherapeutic management of enteric fever are obtained when the treatment is instituted at the onset of the disease. As a rule, the cold applications are employed, and of these the Brand bath enjoys most favor. While with some authorities it has been partly supplanted by le's heroic measures, accumulated statistical evidence attests its efficiency. It is given as follows. A portable tub is placed by the bed and two-thirds filled with witer at 70° F 4n ounce of wine or a spoonful of alcohol is given twenty to thirty minutes before the bath, or four ounces of bot coffee may be administered just be fore immersion. After wetting the face with ice water, the patient is placed in the tub and the entire cutaneous surface mechanically stim ulated by a sponge The unital shock and the feeling of coldne s usually incite desire in the patient to quit the both, but in absence of symptoms of collapse or marked sbuvering, immersion should continue for fifteen minutes Twice during the bath one half gallon of water at 50° F should be poured over the shoulders and head. A slow pulse of small volume does not indicate withdrawal from the bath. At the expiration of fif teen minutes the patient is wrapped in a sheet and blanket, placed on the bed and, if his temperature exceeded 103 5° F, evaporation is per mitted in order to increase heat loss. If shivering be extreme the skin is dried and he is returned at once to bed. Artificial heat is undesirable, but may be needed to insure rejetion, although vigorous rubbing and curtailing the length of the next bath are superior methods of furthering the reactive powers Four to six ounces of ice water are given twenty to thirty minutes after the bith, and an abdominal compress at 60° F renewable hourly is applied. The bath is repeated every three hours or oftener if indicated A temperature exceeding 1025 F, a low mut tering delirium, extreme muscular twitching insomnia, and other manifestations of toxenna demand immediate bathing. The total number of baths is variable as many as one hundred and sevents five have been given to one patient The wonderful results of the Brand bath are shown by the 50 per cent reduction of mortality from typhoid recorded by Dr Thompson from New York hospitals In Australia, of nineteen hun dred and twenty three cases so treated, only 7 per cent died (Hare)

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Gerebral Hemorrhage —The application of an ice-bag or cap or the cold Letter coil to the bead combined with the compresses to the trunk, are the customary hydrotherapeutic measures in treatment of hemorrhage of the brain

Orebral Hyperemia —As this condition usually manifests itself by marked sleeplessness, measures which afford relief for insominy may be effective in lessening the crebral blood supply. Double applications to the spine, coupled with strong friction and cold measures to the head and the wet pack applied from thirty minutes to one hour are the means usually selected to severe the desired (fife.)

Chorea—In evan of heart complications the precorded coil should be applied. Full baths at a temperature from 90° to 98° F, and not allowed to fall below 80° F during the bath of one hour's duration should be given once daily. At the conclusion of the bath the extremities are gently kneaded. Wet packs applied from one to one and one half hours in conjunction with the precordual coil evert a deceded calmative effect. The coil should be applied intermittently at thirty minute intervals. A half bath at 86° F for five to ten minutes should follow the application of the wet packs. A few treatments have effected complete curo in some

Epilepsy—Hydrotherapeutic measures exect a twofold effect in the treatment of epilepsy. They hinder the progress of the disease and re-enforce the action of drugs. Thu with the aid of biddriterapy convulsions may be averted or lessened in screenty by smaller doses of homids and the unplessant condition known as bromism may be avoided. Half baths at a temperature from 80 to 56 F lasting from eight to fifteen minutes and sitz biths at 85 F show valuable effects. The baths may be followed by affusious and nitten o rubbing. In the young and robust baths at 75° F gradually lowered to 65° F and of a few minutes duration are highly recommended by Bins wanger. Hydratic measures are ineffectual to check a seizure once it is firmly established.

Headache—Headache is often caused or accompanied by cortical hyperema so the diversion of the blood flow from the brain and the cord to the superficial vessels is indicated. This may be accomplished by the hot foot bath 4.9 to 50 F, of two minutes duration followed by strong friction is equally as potent. Cold compresses changed hourly should be applied to the bead. The explaiding as forequently a symptom of brain neoplasm may often be lessened by hot mustard foot baths and hot compresses applied to the spine.

Hemicrania—This obstinate malady sometimes yields to wet packs.

applied from one to one and one-half hours and followed by cold rubs

The
drip sheet is recommended Mechanical manipulation and friction, pre-

104° F for twenty to forty minutes, repeated four times daily, lessen the pain, spasm, and tenderness and may modify the disease. Evrly commencement of the treatment so for prime importance. In one series of fits-one cases treated by bot baths the death rate was 33 per cent. The hammock hath at 93° to 100° F may be tried. The following routine is the method of applying the hot high. The principle routine is the method of applying the hot high many fits of the following routine is the method of pplying the hot high. The principle routine is the method of applying the hot high fit high principle routine is the method of applying the lost high fits high principle routine is the method of applying the hot high fit high present in the principle routine is also applicable to the meningsimus of children. If tendeness be extreme the pittent should always be moved bodily on a skeet 41° a risult of the bith the tenderness dimunishes, the temperature falls, the restlessness and spism decrease, and the nations sleeps

Pneumonia - Cold applie itions are selected to treat pneumonia. The e may be the ice bag, the cold Leiter coil, the Brand bath, half bath The ree-bag and coil are placed on the chest and on the head The reduction of the toxemia with strengthening of the heart's action and of the res sel tone is the desired aim of the treatment. The beneficial results of cold hydratric treatment are illustrated by a death rate of about 3 per cent in the report of five hundred cases managed by cold application.

Chest compresses and cross hinders are valued measures. Alcohol given before and after a buth often averts cardiac weakness. The treatment for adults is the Brand bath, the details of which were di cussed under typhoid fever The chest compresses wet with iec water and renewed when dry or warm, or even every ten to twenty minutes, are valuable meas The half bath at 65° to 72° F, of five minutes' duration, coupled with vigorous rubbing and affusions at 50 F, is also effective The icehag should be applied over gauze to the there and base of head An abundance of plain water should be administered, by mouth, if possible A hot mustard foot bath under blankets, to which hot water is continuously added, maintained for forty minutes, is valuable for the diaphoresis it in duces In the aged, adipose, and intemperate the heart must be given careful attention

In children the cool wet pick and sponging give excellent results Compresses from 75° to 80° F, enveloping the child from the base of the neck to the navel, are also used

## DISEASES OF THE NERVOUS SYSTEM

Cerebral Anemia —This may be either a symptom of organic charge in the brain or a manifestatum of morbid processes elsewhere. In either case the underlying disorder should be determined and should be mit with the appropriate treatment. The anemia may be combated by profuse sprinkling of the face and chest with cold water at 75° F.

the least possible disturbance. There is no means of sheltering the child more efficiencies then the continuous warm both properly given. The bath should be a hammock both and all necessary adjustments for the comiter vible suspen ion of the patient in it should be made before he is nowed with all gentleness, and with a slittle noise and disturbance as possible the patient should be lifted up by means of his bed sheet without touching bins, should be carefully lowered into his buth and the bed sheet should le left under him. None other than those needed should be present like buth should contain just chou, h water to cover him it the neck.

The toxic action and the pressure of the serous and of the cellular exudate first irritate the invaded nerve tissues. Most of the acute symp toms result from the irritation of the motor nerve cells in the anterior horn of the spind cord If the irritation continues the nerve cells die und permanent atrophy of the muscle occurs but the first effect is to increase the tonicity of the muscles innervited from the implicated nerve cells so that involuntary and prinful twitching and spasms occur with execcd ing tenderness. The mu cular spism is not only maintained and ag gravated it may even be can ed by external stimule. The hot bath reduces mus ular spasm and provides an unchanging sheltered sedative environ ment in which external stimuli are minimized. Once in the hot bath the patient need not be moved and his exquisitely sensitive nerves are spared the heaviness of bed clothes, and much of the weight of his body terror of approach his a nony on movement quickly diminish and as his muscles relax the troublesome retention of urine spintaneously disappears So far as sleep peace and relief from pain cui trengthen his vitality the warm bath aids him and this aid may suffice to determine a non fatal 189110

Insomna—Sleeplesness is frequently associated with excipted byparams but even if it depends upon other factors the wet pick for one to one and one-half hours is an admirable measure. Nightly site biths it 80° F, lowered two degrees every div. until 30° F is received applied for three minutes are of value. The warm birth at 30° to 98° F applied for thirty minutes before returning may produce akep if the patient after being rapidly dired be hurried into a wirns bed. The room must be warm and there must be no delty between emergence from the bath and entruice into led. When misomina is due to a relative schema of the feet the set returned as a running cold foot bith for a few munutes, followed by drying with a rough towel (Broadbent). A cold wet towel applied around the neck while a pittent is in bed may yield sleep. See bathing often has a soportific effect.

Acute Myehitis—The application of the celd coil to the spine for a long period of time gives the best results. The temperature should be lept at 54° F. When the acute proce a less dwindled half baths and the

eeded by disphoresis induced by the hot air bath or any general measure, may be useful

Hysteria—The treatment is mainly symptomatic sensitivity yield to long continued cold applications. The cold compres of 65°  $\Gamma$  may be used. The cold jet douche util no mittal temperature of 80°  $\Gamma$ , gradually decreased to 40°  $\Gamma$ , applied for one minute, is very effective in diminishing sensory excitability. Anesthesia usually yields to the same amplications. An use rule is often an excellent reactive

The cold Letter cold to the spine most admirably controls extravagual motor activities, such as cough, respiratory spism, and hiscorgh A cold water spiral of 50° F or a biref cold double at the sime temperaturallists the respiratory excitement, while the trouble-some hiscorob is arrested by the application of an abdominal binder in conjunction with a hot abdominal coil. Contrictines, if recent, often are alleviated and removed by the use of the hot coil or full hot baths at 104° to 110° F, if long established, wet packs continued for one to two hours may be true Muscular trought is best combitted by mechanical kineding. If parals is exist brief cold measures are indicated to improve the errant innersessant. The cold rib at 60° F, the cold half bath at 65° F, and cold brief shown buths should be employed.

The following prescription is useful in the treatment of histers, but the light of the minutes, then the circular double, under twenty five pounds pressure, at 85°  $\Gamma$ , and reduced gradually to 60°  $\Gamma$ , is a ministered for thirty seconds. The spray double at 65°  $\Gamma$  is then given for five seconds and finally the jet double at 50°  $\Gamma$  is applied for three seconds over the back. This treatment may need to be prolonged for months.

Infantile Paralysis — There exists at present neither a method to cure nor a means to arrest this dread scourge. Treatment, however, may mitigate the symptoms and by thus exising the patient may conserve his strength and enhance his resistance. I undur puncture relieves the pressure on the inflamed edemations nerve cells and may withdraw some of the noxions agent the toxins circulating in the blood and lymph may be dishited by saline infusions or by blood transfusions, both of these measures will be reenforced by warm buths.

nres will be reenforced by warm boths

Repetted warm boths were formerly used to induce, through sweating
the chimination of the toxins of infantile paralisms. The periodic immersion and removal of the excessively tender victim entailed much suffering
Oppenheim and Wickinan advised against this means of inducing dia
phoresis and recommended the employment of packs instead. But ever
the inaupulations necessary to apply packs are often intolerable. Meddle
some therapy in polionivicities may be diasistrous. The patient must not
be handled. The most enlightened care is that which ensures to the child

soned by trauma an nee pack or a poultice should be employed locally Magnesium sulphite compresses at 50 F may be used for the neutrits due to alcoholism. Wet packs applied one hour daily histen recovers after tenderness subsides. An affusion at 50° to 60° F should follow the pack.

Occupation Neuroses — Shower baths at 45 to fo f f, combused with a fan douche at the same temperature applied locally yield excellent results. The cold coil re-poulitic and the re-bug as continuous mets uns are valuable anytheries. The re-bug and re-poulities should be withdrivin fifteen minutes in each hour Low temperature applications are aided by strong mechanical stimulation. Passive motion is highly effective.

Paralysis —Toyonties and intoricitions are re-possible for many of the limited palaises in these cases the general emuncionies should be stimulated. Circulation to the paralyzed parts should be mereased. The steam bath or the hot air both for eight to fifteen minutes, succeeded by a cold ablution at 45 to  $\sim$  F or a cold rub produces excellent values. The palaises which follow diphtheria are benefited by the daily use of half boths at 70 to 71. F for two to five minutes. Vigorous affusions should accompany these boths

Tabes Dorsalis -- Happy re ults are often produced by alternating temperature applications followed by gentle rubbing. The thermio range of these applications should be very slight Baths at 90 to 100 F for thirty minutes to one hour may be employed. For the arterial spasms irrespective of the site, alternating temperature sitz biths and the cold coil placed to the spine may be tried. As a rule bowever, the crises are little affected by treatment. The following prescription from Hinsdale is effective in the beginning of the disease. The hot air baths for eight to ten minutes, the circular douche under twenty pounds pressure for two minutes at 90 to 105° F tollowed by the jet douche at fifteen pounds at 8,0 to 100 F for one minute. Then for one half minute at 8 .º to 10. F under fifti en pounds pressure the Scotch douche is applied and the fan douche at 80 to 80 F under fifteen to twenty pounds pres sure for twenty seconds followed by an alcohol rub concludes the treat ment. Duly the temperature should be decreased and the pressure in ered ed until the fan donehe reaches 10 F and Scotch and jet douches are driven by a force of twenty punds. Half baths at 50° to 85° F applied from five to ten minutes may be used in the late at true stage. If the ataxis is marked or paralysis is pre ent circular donehes at 100° to 10. I under twenty pounds pre-sure applied for one minute following hithe application of the hot air bith for ten minutes, are of value. The fan donche at 10,0 F to 120 F will merea e the effect of the above Moderate er bathing may be of value but this should be

hammock or continuous both may be employed. Heat should never be used in the early stages of the disease

Chronic Myelitis—The hammeck bith at 95° to 100°  $\Gamma$ , and the continuous bith under the same thermic conditions, may evert a kneffect effect. The half both at a temperature of 83° to 86°  $\Gamma$  given from foor to eight minutes with moderate friction and gently applied affusions should be tried

Neuralgia — Warm boths are of benefit to the neuralgas of the lead The hot foment ition may be tried. In scatter the Scotch douche achieves wonderful raults. The steven calanct or the hot both prek followed is the cool half both may be substituted for the Scotch douche. The latter exerts its greatest effects in recently developed cases. Indeed, one treatment may care. The effect of the jet and the Scotch douche, following a warm application is decidedly happy. A hot air both it to "for eight minutes, followed by a jet douche applied to the same and the affected part for thirty to sixty seconds, beginning at 90° F and decreasing to 60° F, may be employed. Then under twinty pound prevaire the Scotch douche at 60° and 10.° F is directed against the vertebral column. Ice bygs to the seconds neares have been endorsed. The antineur-ligic value of hydrottic measures is demonstrated by the antineur-ligic value of hydrottic measures is demonstrated by the case of Winterint's clime. He treated five hundred and righty five case of all types of neuralgas, and all but twenty nine were cared or improved

Neurasthenia -A 'neurovascular training' as devised by baruch is an absolute necessity to the majority of neurasthenics Great care much be practiced both in the reduction of temperature and in the change of To commence, an abhition of 83° k may be given every morning and dails the temperature be lowered until an ablution of the trunk with very cold water is succeeded promptly by a good reaction Then the ablutions are supplanted by affusious, which are graduated in the same fashion. I ater the drip sheets supersede the affusion The fan douche at 80 F is then applied for one minute to the trunk and the extremities and is followed by the jet douche at 70° F on the bick for thirty seconds The temperature of both douches is decreased one to two degrees duly until the lowest tolerable degree of cold is reached while the pressure is slowly increased to twenty pounds. Half biths at 78° to 86° F, coupled with affusion and rubbing until a good reaction results, are of value I ster, cold applications may follow heat loss the treatment should be given upon arising or after the hot wel pack or hot air bath The salt rub with subsequent fan douche at 900 to 99° F applied from four to eight minutes along the spine, thorax, and extremities possesses great value

Neuritis—The hot applications usually afford great rehef. The hot bath pack, hot compresses, and hot baths of 101° I may be used. The steam douche will be found of value. Should the neuritis be occa.

Hot dry packs for one hour hould follow these measures. Local applications of hot comprisses will often amelorite the pain in very severe access during which there should be no ma sage of the affected parts. In chronic genorrheal arthritis douches are extremely potent measures. They are best applied after a hot air cabinet bath of from five to fifteen min utes duration. The jet douche at twenty pounds pressure is usually employed as a test measure and if it is well tolerated it is continued with gradually increased pre sure up to thirty pounds. In the more chronic cases full pre sure cold douche and in derate manipulations are the meas ures of choice. A circful watch mu t be kept for the usual cardina accompanionicits of an watch earthritis.

Acute Articular Rheumatism -In the c who poses the so-called Acute Articular Rheumatism—In the c who poses s the occalled rheumatic tendencies prophylactic hydrotherapeutic measures may avert the development of the dirit. Moderately cold silt water baths at 65 to 90 F, with subsequent marked rubbing for ten to infteen munited often rectify the rheumatic predsposition. In the treatment of the acutal disea c if the pulse executed 90 and great tenderness be present, baths in the tub are contra indicated. With a pulse at 80 tub biths of an until themprature of 98 F may be used. If endocretitis or perioration by present, the bath temperature should not exceed 08 F at any time The cold precordial coil applied thirty minutes to one hour, two or three times a day strengthens the heart and may prevent the occurrence of cardiac complications. The temperature may be reduced and climina tion increased by the repeated use of the wet pack. Two or three are given, and the last is maintained in place until diaphoresis occurs. Then a bath at 05° to 100 F of five minutes duration is given. In absence a data at 05° to 100° F of fit immittee duration is given. In assence of much pain the private mave be lowered further by a cold rub after the concluding wet pack is removed. An interess in fevr, and pain warrants a reputation of the complete procedure. Midder cases may be treated by sponce baths at 104° to 110° F these minutes with succed in, friction in cold water at 60° and 70° F. If hyperprivatia (10.0° to 106° F.) be precent, the following routine will yield excellent results. The patient is placed in a bath at a temperature of 8, to 95 F which is then slowly reduced to 0 F. The duration of the bath is from fifteen to thirty minutes being concluded when the fever drops to 101 T If the temperature descends even to 985° F after withdrawal from the bath in the alsence of other signs no alarm need be felt

Total might sum sulphate compresses at 140° to 160° F if changed constantly may exist a marked annelsoration after the procedure has been in force twenty minutes Water at 70° F is applied with rubbing after which it in bid is required for at least an hour. Even during our alseence a cold rub should be given upon awakening in order to lessen the danger of relapse

cmployed very cuttously  $\;$  The hammock bath at 100° to 10.5° F  $_{13}$  or benefit

Spasmodic Tic —Cold shower boths at 40° to 55° F for one to two immutes produce the best results in this disorder. In general, standarding measures are applied, but the treatment is unsatisfactory

Mania -In cases of cerebral exertement which accompanies alcohol isin, dementia pracox, chores, epilepsy, parasis, pherperal states, and general acute manuas the bammock both produces excellent results. The temperature of the hath should be between 95° to 100° F and should never fall below 95° F Covering the top of the bathtub with a blanker or other covering prevents heat radiation and tends to keep the ten perature of the water constant. When the bath is continued for averal hours reduction of the excitement is produced. The duration of the bath, if the patient gives no contra indications, is proportionate to the amount of excitement present. When the bath is ended the patient should be quickly covered by a warm blanket and rapidly placed in a warmed hed Daily douches graduated from 100° to 75° F decrease the cerebral evaltation The continuous bath applied daily from ten to twelve hours at a temperature from 95° to 105° T gives even superior results to those obtained by the use of the hammock bath Profuse diaphoresis induced by means of hot air, electric light, or steam cabinets succeeded by a rain bath of five minutes at a temperature of 95° F. decreased to 85° F, 18 of volus

# DISEASES OF THE JOINTS

Rheumatoid Arthritis—Hydrotherapeutic efforts are directed toward of entitigation of pain, the promotion of mobility, and the improvement of circulation Five number applications of the hot air buth (165° F to 175° F) followed by rapid ablutions of water of an initial temperature of 95° F, and reduced one degree each day until 50° F is reached, often yield valuable results. The circular douche at a temperature above 85° F is a useful untiliary measure. Additional means are the circular compresses and the Scotch douche.

Arthrits Deformans — Hot water baths are contraindicated except in the earliest stage of the disease. Hot air biths hot sand baths, and electrically the text went most potent effect in checking its progress. It is possible by these means to reduce the amount of inflammatory fluid in an around the joints, and to increase the range of movement of the articulation, if extensive hyperplava of the joints he not present. The circular jet and Scotch douche applied for a length of time, depending upon the individual case, should follow these applications of heat

Gonorrheal Arthritis —In the acute stage the moist heat of hot baths and hot douches at a temperature of 100° to 105° F is indicated.

When the temperature is high, 106° to 110° F, a cold sheet bath accompanied by strong rubbing should be continued until the temperature reaches 102° to 103° F. During the buth the puttent should have cold water thrown our him and iffer the buth should be placed in bed with the ice-cap in position. I memate gradually reduced from 90° to 15° F. hould be given in amounts from four to five pints. These may be given until the axillary temperature falls to 102. F.

The O Dwyer treatment with iffusions had the best results in the New York, epidemic in 1896. The mortality with this form of management was only 6 per cent while with all other forms it ranged from 11 to "3 per cent. This treatment is as follows covered by a sheet and placed on a stretched on a stretched on a stretched in a time and attending a few feet away from the patient hurls cold water from a dipper on him until the tumperature taken per rectum is 10 ° F. As the body cools vigorous fraction is given.

The cold sponge bath is of value The flower pot ice water spray may be used

## BALNEOLOGY

Introduction —Balacology is concerned with the treatment of disease by mineral waters. A mineral water is water from a natural source, which contains mineral substances in solution. Since no natural water is absolutely free from minerals all waters found in nature may be claved as mineral waters. There is, therefore no sharp distinction between bidicology and hydrotherapy. Hydrotherapy deals mainly with the external application of common water believely with the external and in ternal application of waters from special sources.

The thrapeutic actions inherent in special waters not by virtue of the aptrons riture alone but by ritue of the potency of the dissolved contituents are utilized in balneology. At some springs only drinking is employed at others mainly bitting but at most both britting and drinking are predicted. Vellen waters have specific curarity properties in diabetes and glycourna earthy waters in gravel and stone. Evenus nach is e-pecially efficiences in utrine complaints. Arv la Chapelle, in syphilis. Chemists have oblivorately analyzed the e-waters to detect the clievice property in which the transful power resides. Wears columns of statistics reveal even the most minister traces of organic or inorganic solid or go cous matter which the water contains, but east no light upon the mole of action of the waters. Springs which contain the most diverse, mineral substruces in the proportions which are most di similar enjor apprirently an equal potency in the treatment of the sime divea. Different presons with the "une divease may not be curable at the same

## INTOXICATIONS AND TOXEMIAS

Alcoholism—Acute—The relicf of this condition obtained by the u e of the Turkish bith is a matter of lay knowledge. A prolonged warm bath at 100° to 102° T, with subsequent unctivity, preferably in bed, may be substituted for the Turkish bith

Chronic — Saline infusion may be given for pervous manifestations such as excitement, insommia, and neuritis. They often yield to prolonged wet preks. Many er es respond best to hot tub biths, listing fire to trently minutes, at 102° to 104° F, with subsequent hot picks for ten to twenty minutes. In absence of viscular discress cold sponging may be emploted.

Chrome Arsenic Poisoning—Flimmation of the offending agint is the hydrother-spentic sum. Sterm cromet baths lasting ten to fiftee minutes and the hot air cabinet, for the same length of time, follwed by Scotch and jet douches or a cold run bath, are efficient in this repet Wet packs often ever an analysem effect upon the inten e pain sometimes present in a resement intoxication.

Ohronto Mercurialism—The use of the hot tub bath at 104. I for ten to thirty minutes with the succeeding use of hot dry blanket puls for twenty minutes is advocated. An alcohol rub is usually given when the pack is discontinued.

Chronic Morphinism—The treatment of this habit is similar to that outlined for chronic alcoholism General invigorating procedures are valuable

Ohronic Plumbism — Elimination by all channels should be increased. The means at our disposal to accomplish this is the steam cabinet for fit teen to twenty minutes or the hot in cluim thath. Donches, is the circular or fan, should follow these disphoretic mensures. Cohe my be reheved and elimination from the intestine aided, by enterocless. Three to five litters of warm water may be used, and, if expulsion enuises, may be repeated in one half hour. The hot abdominal coil has also proved of service in controlling cohe.

The hot abdominal coil has also proved of service in controlling cohe. Paralytic conditions are treated by Sooth doubles and cold fan doubles.

Chronic Nicotimism — Here the treatment may be conducted 65 in chronic alcoholism

Thermic Revolutions

Thermic Fever — Treatment should be instituted without delay Cold
measures, combined with friction, are indicated, but some relief ein be
accomplished by simply hurling, cold water against the body face-old
sprays and affin ions, cold sheet inlis with vigorous friction, recold enmetric, and neerubs are the mic sucres usually sudopted. The neepach is per
inclosed Irrespective of the form of treatment used, the patient should be
completely disrobed and frequently renewed re-profit should be placed to
the neck and an nee-cap adjusted to the head.

main disease, conditions which can be remedied by attention to therapeu tie detail. The health resort physician takes cognizance of every mental and physical aspect of his patients. His psychotherapeutic skill is as a rule, far superior to that of his colleague in general practice. Aided by the atmosphere which pervalues such places an atmosphere similar to that which Bernheim helped to create at Nancy and supported by mu nicipal and institutional authority the doctor of the spa is in the position of a health giver whose word is law. His rule is sultiver. His prescriptions are edects of health which all must obey. No private physican could impose such a regime, could practice such beneficent tyraniv as is welcomed at spas. Spas are little more than institutions where higging, bydrotheripy and faith healing are practiced and often the greatest of the six faith bealing.

Composition of Mineral Waters —The mineral waters contain either saline or gasous constituents or both. They are used internally and externally. Externally, they are used as baths partly on account of the stimulating action of their contained sits and gy cs and partly on ac-

count of the elevated temperature which they often have

The mineral constituents of spa waters are derived from the percolation of rain water through the soil and through various strate of the circle surface. On analysis of them odom potassium, in guessium, calcium iron, manginese lithium and aresuse are the usual bases en countered they are combined with hydrochloric sulphuric, earlionic hydrobromic and hydrodic circle sulphuric of Negan carlon divide integers sulphur atch living a carlon divide integers sulphur atch livingers, and other 1325 may be present in solution.

The amount of gas which will dissolve in a liter of water varies with the nature of the gas. Fre h water dissolves more gas than salt water but the most important factor in the solution of a gis is the pressure of the gas The most valuable of the at es m balneology as carbonic acid At 0° C and 760 mm pre sum 1 liter of pure water can absorb 1713 liters of CO, and the olution is saturated It greater pressure more CO2 can be di solved the solution can be upersaturated. The dissolved gas is myrable and its solution is not sparkling. Heat or agitation or reduction of pressure converts the tranquil solution of earbonic acid gas into a spirkling bubbling liquid owing to the throwing out of solution of the curbonic acid gas In comparing the CO contents of virious springs the choose acid gas in comparing the co-contents of virious springs to it is for practical purpo es only nece sure to secretain the degree of supersuturation. Anthony, by experiment determined that the super saturation was 25 per cent at Bud Nanham. 31 per cent at High Rock Baths Saratoga 33 per cent at Kayadero seras Baths Saratoga 38 per cent at Bad Momburg 4, per cent at Bad Kassingen 50 per cent at Bruckenau and Jo per cent at I meoln Bith Stratogs At the I meoln Baths, Saratoga, the greatest supersaturation known in balacology is to

spring Artificially prepared waters of apparently identical composition are admittedly less efficacious, and even questionably useful

To what, then, does the natural source owe its value? Recently radio activity has been demonstrated in the waters of many springs Doubt less such radio activity is powerful to benefit, but the patient must first be thoroughly educated to its significance and then be convinced of its presence. To the less credulous the waters have properties more tan gible and commonplace If analysis shows a special source to be well acrated and to contain sodium, calcium, or other base combined with hydrochloric, sulphingic, or other acid, the ment of the water is that inherent in water the world over, plus that due to its gaseous, metallic, or metalloid constituents. The value of such constituents is their essential value It is no mysterious virtue. Iron or arsenic exerts the same pharmacological effect whether it be administered as a natural solution or as a pharmacentical preparation. The action of alkaline or of sulphurated waters does not vary when it is sought in an Areadian spa and when it is invoked in a crowded town. The worth of believe logical treatment lies not in the water and its contents. These have a certain importance, but the prime factors in the cure are the packet influences which accompany it, the ab ence of work and worry, the change of climate and environment which invest it with healthy interest, the regulation of sleep and diet and exercise which reenforce it, and the medical skill which controls all

In spas, to every mental stimulus of a non religious nature which tends to health, appeal is made. The physician who recommends the treatment begins the theoryentic suggestion by his deeleration of faith in the spa and his panegarie on the evidence of its curative power. I helief in the efficacy of the spa is accepted in natures as part of their national inheritance, one of the virtues of their fatherland, by foreign ers, as conferring upon them at once, a certain desirable cosmopolitan in The pinnacle of faulth is reached by the spa dector who sees in the waters a cure for everything, from fibroid tumors to supernumerary digits. At the spa itself everybody assembles for one purpose—to struct or health. The social instinct imong the similarly such, the atmosphere of solitary competition among convalescents, the regular restful hygiene mode of hife pursued, and the chiratic conditions enjoyed, everse a cumulative curative action on the overstrained, the depressed, and the wear). The regime in itself is curative for the majority of the slightly alting who flock to these resorts. The routine flushing of the system with innoceous fluids chiminates the higgering toxins of vers. In nearly all spass the medical skill at the disposal of the victors is excellent—skill in handling the particular malydies which are specially catered for at the spa and, particularly, skill in alleviating slight conditions superimposed upon the

main disea e conditions which can be remedied by attention to therapeut to ditall. The health re ort physician tikes cognizance of every mental and physical a pect of his patients. His pask-otherapeutic skill is, as a rule, far superior to that of his collesgue in general practice. Aided by the atmosphere which pervades such places, an atmo phere initial to that which Bernheim helpd to create at Naney, and supported by mu meigal and institutional authority the dector of the spa is in the post it of a faelth giver who e word is law. His rule is salutary. His prescriptions are edicts of health which all must obey. No private ply 1 can could impose such a regime could practice such beneficent tyranny, as is welcomed at spis. Spas are little more than institutions where hygiene, hydrotheraps, and faith healing, are practiced, and often the createst of these is futh healing.

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The amount of gas which will desolve in a liter of water varies with the nature of the gas. Fit h water do ofces more gas than salt water but the most important factor in the obution of a gas is the pre-sure of the gas. The mo t valuable of the gass in balneology is curbonic said. At 0 C and 760 mm pressur. I liter of pure water can absorb 171° liters of CO₁ and the solution is saturated. At greater pressure more CO can be dissolved the solution is not spurkling. Heat or agrittion or reduction of pressure converts the transpul solution of carbonic acid gas in invisible and its solution is not spurkling. Heat or agrittion or reduction of pressure converts the transpul solution of carbonic acid gas into a sparkling bubbling highel suring to the throwing out of solution of the carbonic said gas. In comparing the CO continus of various springs it is for practical purpose only nece us to accretion the degree of supersaturation. Authorn by experiment determined that the super saturation was 2... per cent at Bud Nanheim 31 per cent at High Hock Baths Saratoga. 33 per cent at Bud Vanheim 31 per cent at High Hock Baths Saratoga. 35 per cent at Bud Vanheim 31 per cent at High Hock Baths Saratoga and the present at Bud Nanheim and the present at Bud Nanheim and the present at Bud Nanheim in the langelogy is to Baths Saratoga the greatests supersaturation known in balneology is to

be found The efficiency of the Nauherm Bath is largely due to the action of carbonic acid gas hubbles on the skin. This action can be obtained in unequaled degree at Saratoga Springs, New York

Temperature -The temperature of the waters varies reatly Waters which issue hot, derive their heat from that which exists at great depths in the earth. Indeed, it has been alleged that the hotter the spring the deeper is its source Springs that have a temperature above the average of the locality in which they occur are called thermal Thermal springs of a temperature between 70° F and 98° F are distinguished as varm and those above 98° F as hot The temperature of the waters at Airla Chapelle is 167° F , at Carlshad, 162° F , at Bith, 120° F The follow ing list (Hinsdale) gives the location and distribution of the chief thermal springs in the United States

rings in the United States	
	Temperature De _h rees F
Takanan Caranan Galambar Ga Maria Sart	15
Lebanon Spring Columbia Co New York	12
Spring near Carlisle Perry Co Pennsylvania	14
Rockbridge Baths Virginia	15
Sweet Chalybeate Alleghany Co Virginia	69
McHenry's Thermal Spring Scott Co Virginia	84
Healing Springs Bath Co Virginia	
Warm Springs Bath Co Virginia	963
Hot Springs Bath Co Virginia	106
Berkeley Springs Morgan Co Virginia	14
Sweet Springs Monroe Co West Virginia	<u>.</u> 9
New River White Sulphur Giles Co West Virginia	ب
Hot Springs Buncombe Co North Carolina	92-117
Citadel Creen Charleston South Carolina	99 5
Warm Springs Meriwether Co Georgia	10- 90
Livingston Spring Sumter Co Alibama	69
Bailey s Springs Alabama	72- 40
Hot Springs, Arkansas	46-141
Hot Springs South Dakota	99
Liberty Hot Springs Colorado	140-150
Hot Springs Canyon City Colorado	16°
Hot Sulphur Springs Middle Park Colorado	110-11:
Glenwood Springs Colorado	174
	106
Idaho Springs Colorado	110-140
Las Vegas Springs New Mexico	140
Hudson Hot Springs New Mexico	90-107
Ojo Caliente Taos Co New Mexico	

At thermal baths local painful conditions, nerve or joint troubles of

gouty or rhenmatic origin, are treated

Radio activity -The radio activity of mineral waters arises from the presence of a gas known as the radium emanation This gas is derived from the radio active salts contained in the earth where the spring has its source The emanation is soluble in water but decomposes continuously at a known rate, and, like other gases is driven out of solution by boiling

Radio-activity is estimated by means of the electroscope or, with greater recurrent of the fontactoscope of English and Sievaking. The result is stated in Mache units (M U ) but confusion in standardizing the units exists so the radio-active values of various springs are not easily judged Shearer in his report upon the radio activity of Glen Springs states that the Nanheim Spring there contains 68 M U per liter and cites from I adium (\pril, 191a) the radio-activity of Hot Springs Arkansas, as varying between 0.7 and 236 M U of Saratoga Springs, 108 and 104 M U and of Colorado Springs 0.21 and 104 M U Semblin quoted by Hin dale estimates that there are 214 M U per liter in Magnesia Sprin, 214 M U in Boiler Sprin, 157 M U in Hot Sulphur Spring and 101 M U in Suimming I ool Spring at Hot Springs, Virginia Padroactive inneral waters are used chiefly to ac celerate metabolism Success is said closely to attend them in the treat ment of the metabolic toximus which can e gouts and rheumatoid states with accompaniments as myositis neuritis and arteriosclerosis

#### CLASSIFICATION

The smounts of the various constituents vary greatly in different sources 'according to the essential constituents of the water sources are classified as indifferent alkaline salue chals beste sulphurons etc Man waters do not klong to any one group. Thus, saline sulphur springs are common, others could rightfully be classed in any of several categories. Hence, this mode of the sification does not distinctly differ entiate but mercly groups somewhat similar waters conveniently together. The following are some of the most important sources

Simple Thermal Waters -- Simple Thermal Waters include waters of high temperature and small mineral content

Imerica - See list connecrated under Temperature (page 456)

Great Britain .- Bath Luxton Watlock

France -Bigneres de Bigorre Neris Bagnoles de l'Orne Plom bicres, Dax St Amand

Germany and Austria - Bidenweiler Teplitz Boliemia, Gastein Salzburg Austria Wildbad Wurttemberg Schlangenbad (near Wies baden)

Italy-Eattaglin Bormio Pozzuoli

Surtzerland -Locche-les Bains I agatz

These waters are usually soft they are not frequently used inter

nally, but are employed almost olely as baths

Common Salt Waters - As common salt is of almost invariable occurrence in natural waters this class has indefinite and arbitrary limits In the waters which are here mentioned common salt is the essential constituent

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Spring near Carli le Perry Co Penusylvania	12
Rockbridge Baths Virginia	, 4
Sweet Chalybeate Alleghany Co Virginia	19
McHenry's Thermal Spring Scott Co Virginia	69
Healing Springs Bath Co Virginia	67
Warm Springs Bath Co Virginia	96 a
Hot Springs Bath Co Virginia	106
Berkeley Springs Morgan Co Virginia	14
Sweet Springs Monroe Co West Virginia	19
New River White Sulphur Giles Co West Virginia	۹۵
Hot Springs Buncombe Co North Carolina	97-111
Citadel Green Charleston South Carolina	39 5
Warm Springs Meriwether Co Georgia	70- 90
	69
Livingston Spring Sumter Co Alabama	72- 0
Bailey s Springs Alabama	4h-141
Hot Springs Arkansas	94
Hot Springs South Dakota	140-1-0
Liberty Hot Springs Colorado	167
Hot Springs Canyon City Colorado	110-114
Hot Sulphur Springs Middle Park Colorad	194
Glenwood Sorings Colorado	100
Idaho Springs Colorado	110-140
Las Vegas Springs New Mexico	147
Hudson Hot Springs New Mexico	40-192
Ojo Caliente Taos Co New Mevico	

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## CLASSIFICATION

The amounts of the various constituents vary greatly in different sources 'tecording to the essential constituents of the water sources are clas thed as indifferent alkaline suline chall beate sulphurous, etc. Many waters do not belong to any one group. Thus sultue sulphur springs are common others could rightfully be classed in any of several springs are common others could rightfully be classed in any of several categories. Hence this mode of classification does not distinctly differ entities, but increly groups some what similar waters conveniently together. The following are some of the most important sources.

Simple Thermal Waters—Sumple Thermal Waters include waters of high temperature and small mineral content.

imerica -See list enume rated under Temp rature (page 4.6)

Great Britain-Bath Puxton Watlack

France -- Laguer s de Bigorre Neris Bagnoles de l'Orno, Plom bieres Dux St Amand

Germany and Instructure Badenweiler Tephtz Bohemin Gastein, Salzburg Austria Wildbid Wurttemberg, Schlangenbad (near Wies badeu)

Italy —Batta lia Bormio Pozzuoli Suit erland —I ocche-les Bains hapatz

These waters are usually soft they are not frequently used inter nally, but are employed almo t solely as baths

Common Salt Waters - 15 common salt is of almost my mable occurrence in natural waters, this class has indefinite and arbitrary limits. In the waters which are here mentioned common salt is the essential constituent

be found The efficiency of the Nanheim Bath is largely due to the action of carbonic acid gas hubbles on the skin. This action can be obtained in

unequaled degree at Saratoga Springs, New York

Temperature - The temperature of the waters varies greatly Waters which issue hot, derive their heat from that which exists at great depths in the earth Indeed, it has been alleged that the hotter the spring the deeper is its source Springs that have a temperature above the average of the locality in which they occur are called thermal Thermal springs of a temperature between 70° F and 98° F are distinguished as warm and those above 98° F as hat The temperature of the waters at Ax h Chapelle is 167° F , at Carlsbad, 162° F , at Bath, 120° F The follow ing list (Hinsdale) gives the location and distribution of the chief thermal springs in the United States

	Temperature Degrees F
Lebanon Spring Columbia to New York	15
Spring near Carlisle Perry Co Pennsylvania	1,3
Rockbridge Baths Virginia	14
Sweet Chalyberte Alleghany Co Virginia	15
McHenry's Thermal Spring Scott Co Virginia	89
Healing Springs Bath Co Virginia	94
Warm Springs Bath Co Virginia	963
Hot Springs Bath Co Virginia	10b
Berkeley Springs Morgan Co Virginia	,4
Sweet Springs Monroe Co West Virginia	9
New River White Sulphur Giles Co West Virginia	۹۵
Hot Springs Buncombe Co North Carolina	9?-11:
Citadel Green Charleston South Carolina	99 5
Warm Springs Meriwether Co Georgia	0-90
Livingston Spring Sumter Co Alabama	68
Bailey's Springs Alabama	77 <u>-</u> 40
Hot Springs Arkansas	46-11:
Hot Springs South Dalota	99
Liberty Hot Springs Colorado	140-150
Hot Springs Canyon City Colorado	16°
Hot Sulphur Springs Middle Park Colorad	110-117
Glenwood Suring Colorado	101
Idaho Springs Colorado	100
Las Vegas Springs New Mexico	110-140
Hudson Hot Springs New Mexico	140
O10 Caliente Taos Co New Mexico	90-197

At thermal baths local painful conditions, nerve or joint troubles of

couty or rheumatic origin, are treated

Radio activity -The radio activity of mineral waters arises from the presence of a gas known as the radium emanation. This gas is derived from the radio active salts cont uned in the earth where the spring his its source The emanation is soluble in water but decomposes continuously at a known rate and like other gases is driven out of solution by boiling

Germany and Justria. Bocklet Pyrmont Waldeck, Bruckenan, Pippoldsau, Elster, Savony Schwalhach Petersthal

Italu -Santa Catarina

Sustrerland -St. Moritz

Calcareous Group -The e waters contain salts of alkaline earths cal cium and magnesium sulphate, and carbonate

Imerica - Cherry Valley, New York Holston Virginia, Chittenango New York, Waukesh's Wisconsin Chifton Springs New York Tate Epsoin Tennessee, Bedford Pennsylvania Vium Lock California Catoosa Georgia, etc.

England -Bath

France - Bagueres de Bigorre Contreveville Vittel

Germany and Austria - Inselbid Lippspring Wildingen

Sustzerland -Loeche les Bains Weissenberg

Sulphur Waters -These waters contain sulphids Many of them also contain chlorids. Some of them are warm

America.-Calistoga Springs California Santa Barbara Springs, California Glenwood Springs Colorado Hot Sulphur Springs, Colo rado also in Utah and Arkansas

British Isles - Billynchinch (Co Down Ireland) Harrogate Eng land (13 per 1 000 N 1Cl) Llandrandod Wells Wales Moffat Scotland.

Strathpeffer Scotland

France - Aix les Bains (Warm) Louchon Allevard Pierrefonds, Amelie-les Bains (hot) St Honore-les Bains Barage St Sauveur. Canterets (warm) Uriage Lany Bonnes (warm)

Germany and Justria - Ary la Chapelle Baden Weilbach, Nassan Suitzerland - Baden Heustrich Schinznach Gurnigel Lenk

Egypt --- Helouan.

Arsenical Waters - These waters contain arsenites or arsenites

America - Crockett Arsenie Lathia Springs (Virginia) Thompson s Broming Arsenic North Carolina Harbin Hot Sulphur Springs Cali forma

France -I a Bourboule Bons ang Vals

Germanu and Justria-Cudowa Roncegno Linda Pansa Levico South Tyrol

Italy - Civilina Ceresole Reale

# THE ACTION OF MINERAL WATERS

The effect of the ingestion of the large quantities of water which forms part of the routine treatment at mineral aprings as to flush out the stomach intestine kidneys and other organs. The water, by its bulk, stimulates peristalsis and roids in solution or suspension, the putre cent material from the bowels. Some of the water is absorbed. The bulk of

America - Fruit Port, Michigan, Grand Haven, Michigan, Mount Clemens Mineral Springs, Spring Lake Well, Salt Spring, Virginia. Ocean Spring, Alabama

Great Britain - Droitwich (brine, 300 parts per 1,000), Worcester shire, Nantwick (brine), Woodhall Sna (chloro bromo iodid), Lincoln

France -Bourbonne les Bains (hot), Salies de Bearn, Chateleuvon (warm, gaseous). Salins du Jura. La Monillière (chloro bromo-iodd).

Salins Moutiers (warm)

Germanu and tustria - Baden Baden (weak, 2 parts per 1,000), Nauheim (warm, gaseous), Hesse (near Frankfort-on Main), Berchtergiden, upper Bayaria Ocynhausen, Westphalia, Homburg (cold, con tain also bicarbonate of iron) (near Frankfort-on Main), Ischl, Salz kammergut Austria, Reichenhall, Bavaria, Kissingen, Bavaria, Soden (near Frankfort-on Main), Kreuznach, Rlune Province, Wiesbaden (hot)

Suitzerland -Bex, Wilderg

Alkaline Waters -- Waters containing sodium bicarbonate subgroups (1) simple alkaline waters, (2) alkaline and common salt

waters. (3) alkaline and sodium sulphate waters

America - Capon Springs, Virginia, Glenwood Springs, Colorado, Glen Summit Springs Pennsylvania, Geyser Spa, Culifornia, Gettys burg Springs Pennsylvania Manitou Soda Spring, Colorado, Minnequa Springs Pennsylvania Saratoga Springs, New York

France -Vals, 1, 5 Vichy, 1, Alher, Royat, 2

Germany and Austria - Bilin, 1, Fachingen, 1, Carlsbad, 3, Bohemia, Neuenahr, 1, Coblentz Franzensbad, 3, Bohemia, Ems, 2, He & Nassan, Marienbad, 3, Bohemia

Suit-erland -Tarasp. 3

Bitter Waters -These contain chiefly magnesium sulphate

Great Britain.—Cheltenham (chlorids also), Leamington (chlorids alsol

France -Brides

Germany and Austria. - Apenta Friedrichshall, Pullna Spain -Rubinat

Chalybeate or Iron Waters -These waters contain iron in medicinal quantities

America - Rawley Springs Rock Iron Springs, Church Hill Alum Springs, and others, Virginia, Sharon Springs, Saratoga Springs, New York, Pacific Congress Springs California

England -Tunbridge Wells

France -Forges les-Eaux. Orezzi

Belgium -Spa

The figures refer to the subgroup

Iron Arseneal Sulphide and Earthy Waters—Waters containing from and arsenic in sufficient amounts to be of thempeutic value exert merely the ordinary pharmacological action of these substances. They are in ed mainly in anomals, neural-yas, and skin discuss. The action of the sulphide waters is not cyclet. They are said to stimulate secretion of bile and to have an expectorant action. Then use in syphilis is greatly lauded, but where it is most evalide in a resure is also given as a substantial prop to its curative powers. Sulphids in sufficient quantity are protoplas into possons. For clevis the sulphide numeral water as an alterative is to admit incorning of the basis of its action. The earthy waters those continuing the sulphiates and erbonates of calcium chiefly, have probably little action ipart from that of the water. They are given as antacid, is a string-cuts and seditives in read dispepsia and in diarrher. Their length flushing power is used in hepitic and gouty conditions, and in chrome existing gravel and stone.

Resultant Action of Mineral Waters—Few waters have only one content. As the waters were classed according to their predominant constituent, so is their action regarded as being that mainly of this essential constituent; but the predominant constituent of any mineral water is not that which eccurs in great e quantity but that which is most active indicate the predominant some waters containing, small quantities of arsenic exert more action by virtue of their arsenic than they do by virtue of all their other constituents. We therefore have to deal with compound actions some of which are negligible and once of which are important. Of the important actions some reinforce and some tend to neutralize those of the other constituents. The price of effect therefore of any given immeral water is the resultant of a main actions that it is difficult to presseg, and we must more, or less empirically bese our expectations of its value upon observations of physicalize and pritents.

In addition to these mineral futures the presence of carbonic acid gas also modifies the action of the waters. The carbonic acid is supposed to be at once stimulating and sedstine. If certainly renders waters more pleusing to regard and more palarible to take. The physical effects of the impact of fas bubbles inpon the skin are utilized in stimulatine, baths

pressing to regard and more pararine to take. The physical eneets of the impact of gas bubbles upon the 4km are utilized in stimulating baths. Many mineral sources yield waters at bigh temperatures and the temperature also modifies the therapentic action.

### INDICATIONS 1 OF AND CHOICE OF, A SPA

For those who have the labit of vecess in work or in pleasure a periodic vinit to a spi is a useful precaution. For others 'taking the cure is an essential part of social routine. For others again, especially the middle aged in easy circumstances who seek rehelf from the techum of living by intensive devotion to minor allments the spa is a refuge to the circulating fluid is increased, the greater volume affords endocardul stimulation and the circulator, efficiency may be enhanced. The resulting increased blood pressure promotes duress. The vital process are all quickened, tissue change increases, mucous membranes scrite more freely, and the skin glands function more actively. To dilute torus to dissolve them, and to promote their exerction, are the main actions of water.

But a feeble atomic storach musculature may not lightly tolerate the ingestion of large volumes of water, embarrassed hearts may perceptill full under the added burden which must be propelled, and overworked diseased kidneys may quickly be exhausted by the laborious functional activity thus demanded

Action of Salines—The divisite and irritint properties of saliest inhibit absorption of liquids, anginent peristaless, and increase the flad contents of the intestines, so as to produce mere or less free purgation. The presence of increase of salts in the blood causes a litelier interchange between the circulating blood and the fluid in the tissue spaces diurius causies, a mild expectorant action is produced, and metabolism generally suppressed.

Salines are said to increase the solubility and diffusibility of albumus. In food a considerable amount of salt is customarily ingested. How far the added quantities of salines, which are absorbed during mineral water curves, evert an influence on metabolism, is doubtful. The action of the salines viries somewhat according as the base and the acid radical which they contain. The action of the metallic climent need not further he discussed here. The rate of diffusion of chlorids, sulphites, and indistinguished the content of large molecular weight, such as sulphites, diffuse with difficulty and, therefore, tend to act mainly as enthanties. Whereas, with ridicals of large molecular weight, such as shlorids, an interchinge takes pives right to be tween the bowel contents and the portal circulation so that a considerable proportion of the salt may be ingested. Turther details at regards the mechanism of the action of salines belong more properly to the realm of pharmicology. Salt and bitter springs are used in constitution, portal stagnation, chronic gastro-enteritis, chronic respiratory, petre, and rheimstate conditions.

and rheumatic contitions
Alkahs —The alkaline waters increase the alkalinity of the blood
plasma, promote tissue changes, increase metabolism, and tend vias to
increase the alkalinity of the urine. As alkalinity promotes the action
of the salva, bile, pancreatic, and intestinal junces alkalis enhance days
tion. Alkalis are alleged to facilitate respiration (Voit) not only in
the tissues, but also in the lun,s, by acting as eirbonic acid carriers. The
alkaline waters are used in acid dyspepsis, constipation, gall stones gravil,
gout, glycosuria, and obesity.

morbid process, but also may so tone the weakened heart that edema, pain and brethlessness disappear and then by carefully regulated training the circulatory system may be further structhened so that even under considerable exertion the heart acts strongly, regularly and without emburas ment.

In chrome diseases of a less hopeful degree spas afford rehef from the witness and monotony of prolonged home treatment. New surround ings, new physicians, new therepentic measures seldom full to relieve the depression, and they enhance the vitality of chrome invahils.

There remain a few pas which are merely hath houses,' but the modern spa is in the truest sense a health resort. Spr theraps is not con fined to baths dicts and everer o Drugs and every measure which can combat disease are utilized sometimes even to the exclusion of hydrotherapy Thus, at Clifton Springs near Rochester New York, the spa is organized under the able direction of Dr M S Woodbury into depart ments of internal medicine, neurologs surgers and pathology Hydro theraps balneology, electrotheraps physical training and industrial therapeutics are all used there as adjus into to rational treatment excellent institution is operated under a trust deed which requires that all receipts in exce s of expen es be devoted to improving the institution and to the care of patients at reduced or free rates. In other spas such as Hot Springs, Arkansas the American Aix la Chipelle and Mount Clemens Michigan, the main endeavir is to cohance the efficacy of drug treat ment of disease. In these last two institutions unrivaled facilities for the treatment of syphilis exist. The administration of mercury by expert rubbers in a careful systematic and thorough fashion insures as fir as is humanly possible freedom from the dread sequelas of this disease and mitigates or removes such symptoms as may arise. The absorption and elimination of the mercury is sided by bathing. The treatment is not confined to mercurial inunctions arsphenamine and other drugs are also used in appropriate cases Particularly happy results are attained in the nervous manufestations of syphilis in which the physical therapy relieves pain promotes nutrition and strengthens the musculature while the drug treatment attacks the essential cause of the malady

All chronic diseases except a few such as epilepsy and tuberculous Most vertimes may be undesirable associates for other sufferers are treated at spas. Some spas, however becau e of their situation or because of the character of their waters are traditionally efficacious in the treatment of special diseases. Thus at Krunsnach Woodhall and Khasingen evudates from chronic endometritis perimetritis and salpingnts are said to dis appear, even fibroids have been alleged to melt before the solvent action of these waters. At Mannheim and at Rheine cardiac and joint sequelar of rheumatic fever are surved. Schlangenbud is especially lauded for the relief of the neuralign which so often follows influenze and malaria, the relief of the neuralign which so often follows influenze and malaria, the

which they retire from the monotony of family and social life, and in which hygienic, dietetic, and medical discipline provides them with an excuse and with an opportunity for cure

For tardy convalescence the spa is eminently desirable but not always necessary In many cases, as in chlorosis, change, alone, is needed. The anemic country girl visits a town and quickly improves town girl returns rosy from the sea, the moors, or the mountains The new regime and environment are sufficient to bring about the desired cure In other cases the chief factors of benefit in the enange are fre h air and exercise for such the locality chosen should have a slight rainfall in order to insure the possibility of outdoor life, the temperature is les important, for appropriate clothing and exercise will maintain the body heat But the value of warmth in winter, to those convalescing from painful nervous and rheumatic conditions, and of coolness in the summer to invalids from hot stuffy towns, is too well known to need emphasis But when a change is imperative and medical care is still necessary the patient hould be sent to a spx Good symiation, comfortable quarters, and constant care can there be relied upon If a special climate be slan desired, all climates are available to the fortunate residents of the United States, and there also is a choice of many different kinds of spas at the same latitude

But the main sphere of the spa is the treatment of chronic diseases. In the metabolic diseases the eliminating channels are cleansed and main tained clean by the ingestion of the mineral waters and by bathin" dietetic discipline is enforced, so auto-intoxication ceases, physical therspy is practiced which together with the radio-activity of the waters, promotes oxidation The control of the hulk of the food and the regular emptying of the alimentary canal enables the weak and overstretched muscles of the stomach and bowel to renew their tone Massage for the feeble and for those in pain, passive movements, regulated either by masseurs or by the ingenious mechanical appliances of Lander, active movements, in the recumbent posture for the weak, walking carefully controlled distances on level surfaces, or for the stronger up measured slopes, and finally, gymnastic practice swimming tennis, golf and other outdoor sports,these means strengthen feeble cardiac and vascular muscles, tone the flabby voluntary muscles and promote the circulatory, digestive and mental processes

Under suitable treatment by biths, mineral waters, diet and physical exercises, metabolism is thus quickened, obesity is reduced, deposits diminish around thickened joints and in inflittated muscles, pain, therefore, is alleviated, movement returns and wasted muscles recover. Diseased kidnews are rested and their work is lightened to their power to function properly.

In cardiovascular diseases such treatment not only may arrest the

tuted by the private physician, then a home spa may be utilized in order to strengthen the patient for the long rough journey, or the stormy sea voyage, or the rigors of the new climate and then the possibly more de sirable and efficacious foreign spa is attempted. Thus in severe heart cases a modified Nauheim treatment may first be instituted by the private physician, then a bome spa may be utilized in order to strengthen the patient for the long rough journey or the stormy sea voyage, or the rigors of the new climate, and then the possibly more desirable and effi cacious foreign sna is attempted

Climate of Spa -As regards the climate raw damp cold regions would naturally be contra indicated in acute pulmonary conditions or in convilescence from pneumonia. High altitudes while dry and rare and calm, afford greater variations of temperature and are not desirable for the skepless and mentally distres ed nor should they be visited by severe heart cases, arterioselerotics, apoplectics and those with a tendency to hemoptysis Then convalescents from scute diseases also had better not be sent to mountainous health re orts. For all these the sea level is better. for the sea climate is more equable

The Spa Itself -The chemical composition of the water is not a matter of great moment. More important are the bathing facilities the provision for physicotherapy and the housing arrangements. Unless good food and good accommodation are insured the spa should be avoided For the slightly ill the social life of the spa is an important therapeutic factor But the most essential point of all in the choice of a spa is a knowledge of the medical skill available A spa where a local physician is personally known to the physician who sends the case should if possible. be selected Just as a physician would not readily recommend his patient to a surgeon for whom he could not personally touch, so should he he chary of committing his case to the care of an unknown health resort physician Arrangements for the patient should be made before the Journey is commenced so that when the invalid arrives at the soa all unnecessary discomfort and delay may be avoided. With the patient a full account of his malady and its treatment should be sent. Much must be left to the discretion of the local physician at the health resort, but the family physician should know whatever is proposed for the treatment of the patient he sends why it is proposed and what it promises. Home spas should always be recommended whenever possible. The season at most spas is from May 1 till September 30 Many, however, especially those with thermal springs, are winter resorts also

## TAPOY CONVALENCENCE

A patient convalescing is in a state of physical and mental instability and has so little reserve strength that fatiguing journeys must be avoided obese and the gouty are catered for at Carlsbud and Marienbad, the syphilitic, at Aix la Chapelle, and so forth. This specialization is of great value Every facility which science has devised for the treatment of the selected disease is provided at the spa. The spa physicians have a vast experience of these special ailments and great skill in their treatment, and the competition for health among the similarly sick at such sois is of considerable therapeutic value. Hence these spas often confer a more rapid, a greater, and a more permanent improvement than home treatment can attain

American spas are not yet specialized as European spas At Glen Springs New York, particular care is given to cardiovascular discares. The Nauheim spring is rich in calcium chlorid, and its brine is five times more concentrated than that of Bad Nauheim Springs at Saratoga are so numerous and so diverse in composition that the witers are especially suited for the treatment of many maladies, among which tress is laid upon digestive disorders, chrome rheumitism and sciatica. The excellent work of Dr Charles G Anthony in supersaturating the Nanheim baths with carbonic acid has makes them unequaled At Virginia Hot Springs, the American Aix les Brins, special study is given to metabolic discases The hot baths and the genial climite are grateful in myositis, ciatica, neuritis and rheumatoid conditions, and the radio-activity of the waters enhances their value At these springs there is an excellent installation of Lander apparatus and physical therapy is well organized White Sul phur Springs, one of the most luminous health re orts in the world, has a splendid climate, and excellent bithin, facilities Waulesha Springs Wisconsin, is given up to the treatment of severe functional disorders of the nervous system

War has made European spas inaccessible at present, and the residual hatred among the belligerents will long deprive the German and Austrian spas of much of their cosmopolitan charm. In the meintime the wealth of balneological resources which the United States possesses is slowly being realized by Americans The authorities have begun to conserve this wealth the patients to appreciate it Foreign spas offer no therapentic facilities which cannot be equally obtained, both more easily and more comfortably, by Americans at home

Unless the patient's physical state warrants the strum of a journey the suggestion of a spa should not be made Havin, determined that 1 spa is desirable, the physician considers the accessibility of the spa, its climate, its elevation above sea level, the accommodation it provide, the nature of the waters, the bathing, massaging, and other therapentic facilities, and above all the quality of the medical care available These considerations determine his choice In weakly patients a preliminary course of treat ment may be necessary at home before any journey is attempted Thus, in severe heart cases, a modified Nauheim treatment may first be insti-

Cardiac Diseases -With cardiac cases careful consideration is im perative before a visit to a spa be attempted. In severe valvular conditions the patient is better at home. Long journeys and bulky water treat ment are more liable to kill than to cure. If sna treatment by contemplated in such cases a preliminary course of Nauheum hiths (see Chronic Myo cardial Insufficiency) should be given at home. The heart muscle should also be strengthened by cardiac tonics such as strophanthus or digitalis Even when the valvular disease or the myocardial change be not severe the coursey should not be rashly undertaken and it is desirable to travel by short stages

A beginning should be made with rest after the journey Then Nau heim baths of short duration and about body temperature should be given Cradually the baths may be cooled and lengthened Then the carbonia acid gas may be added to them Finally the Schott exercises may be at tempted Later the Oertl treatment regulated walking and the climbing of slopes may be practiced when the beart has been strengthened enough to allow of its use

The bearts most benefited by spa treatment are the weak fat flabby hearts of overindulgence in everything except exercise . The dietetic and hygienic regime and the graduated work often act as a charm in such cases If the heart is weak graduated exercises are very cautionals in itiated Passive movement alone is first attempted, next active movements, then resistance movements and tinally the Oertl exercises. In the dilated fatty beart of anemia the cause of the anemia should be the chief object of treatment. The guiding principle should be 'to hasten slowly Excessive work may damage a dilated heart so as to require months of treatment to remedy the indiscretion. Very little good comes from the incestion of water and positive harm may accrue if the water be serated

Renal and Bladder Diseases - Since the work of von Noorden and his school the popularity of balneological treatment in kidney diseases has rapidly waned. It is now generally admitted that to fatigue the kid neys by imposing upon their already feeble energies the labor of excreting large quantities of fluid is a cour e of very doubtful therapeutic wisdom

The cause of gravel hes m dictetic errors No treatment should be instituted before the precise chemical composition of the urmary deposit is determined. Then rational dietetic measures are the best means to combat the tendency. To render the urane alkaline by ingestion of alkaline waters in bulk is to precipitate the urinary phosphates and to add a phosphatic layer to the calcareons nucleus already present

The p c 1 indication f r Nauh m t estment is chron c myocardial insufficien v of the fi at a d second degree t should nev r b employed in the third stage (see Chronic Myocard al I sufficie y) -- EDITOR

All spas which practice heroic methods are emphatically contraindicated No "flushing' treatment to exhaust the heart and to fatigue the kidners should be considered. A change of air alone may he all that is necessity If a spa be selected it should be one in which the treatment is gentle and not fatiguing-a mild, near, warm, sheltered spa, at a low altitude If the nationt is markedly anomic a spa with iron waters or with iron and salt waters should be chosen

#### SPECIAL BALNEOLOGY

Diseases of the Blood-Anemia -It is essential, first, to consider whether the patient be suffering from primiry or secondary anemia In the primary anemia of adolescents constipation is so often a causative factor that good results are frequently obtained by the use of the mild aperient waters of any of the salue or thermal springs alone may effect a cure But before, during, and after the spa treatment pharmaceutical preparations of iron mit be exhibited. If a mixed salt and iron spring he available the treatment may be begun there and then finished at another spring containing more iron Often climatic change alone suffices to effect a cure, and no change as more generally u eful than that which is obtainable by a sea tovage. In the anemia which fol lows repeated losses of blood from hemorrhoids, the mildly purgative springs, which tend to reduce portal congestion, are indicated. In the anemia due to chronic renal conditions, great care is necessari the dis eased kidneys are already overstrained, the demand made upon them by the ingestion of a great volume of fluid may complete their undoing In the anemia of incipient tuberculosis, especially that complicated by hemoptysis, a warm, sheltered, low altitude spa is desirable. In the anemia of syphilis, sulphur springs, such as Aix la Chapelle, are recommended In all anemias it is essential, first, to recognize the underlying cause and then to choose the spa suited to the treatment of the primary discuse

Diseases of the Respiratory Organs -The mun respiratory diseases seeking balacological treatment are chronic bronchitis and emphysems, astbma, and tuherculosis Persistent traces of exudate after pneumonia are also often subjected to spa treatment. The essence of the treatment, so far as the respiratory tract is concerned, is to improve the climatic con ditions Bronchitis and emphysema arise from many causes—respiratory, renal, cardiac, vascular, etc The cardiac and vascular, and perhaps the renal case, may be benefited by appropriate waters The slight expectorant action of the alkaline and saline waters may also directly help the relief of the morbid process in the lungs. For the tuberculous patients rest, feeding, sun and light, and fresh air baths are necessary

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Risch, Wintermitz, Goldstein, Lersch, and others Hydrotherapy and Balneology Articles in I cal Encyclopadie der gesymmeten Heil kunde edited by Eulenber, Wien und Leipzig, 1894 finching of the minary system with waters containing small amounts of calcium carbonate and phosphate—the so-called earlily witers—is in itself harmless and of little efficiely. Equally good results could be obtained by drinking quantities of warm water on an empty stomach at home. As the cause of calculus formation is usually discuss of the bladder will, local medicinal treatment of proven value must not be neglected for the more grainental but less useful bath treatment.

Rheumatism — No one would think of moving a cise of acute thematism to my spa, however prinseworthy. In the prolonged convoluence which follows sometimes, in cases which persistently relapse slightly, which continue to have trader, painful joints, which show slight valviur or myorardial changes, or which are pronouncedly anemic, a charge to a spa often works would risk. When joint changes are the main important to health, when thickening and effusion persist, i spa should be chosen with alkaline or sulpharated saline waters, a lost spa, a spr in which Zander exercises, missage, and good betting facilities are obtainable, so that absorption of the morbid products may be hastened. When evidual troubles the residue, then Glen Springs, Clifton, Saratog, i or some other synwhere cardiac troubles are especially treated, should be selected. The nature cases should be sent to an iron saline spring. The climate of the sun selected should be enable, warm, and dry

spi selected should be equable, warm, and dry

Almentary Disorders—It is among the indiscret of habit the people
who work too much and cut too little, and those who eat too much and
work too little, that the benefits of spi treatment are most pronounced
in the dispeptic, the gonty, the "livery," the spas find their most griteful
patients. The myriad of minor allments of alimentary origin, and of
importance in direct proportion to the neurotic and to the financial disp's
tion of the patient, yield to the dicteit, regulation of the spa. The purgation waters clear the chimnels of life from necumulations of ages. Costipation is not permitted the portid circulation is stimulated to activity
hepatic congestion disappears, and piles and pelvic disorders are ming-ted
or banished. The gouty concretions are dissolved, the system is flushed
clean contributory dietetic errors are rectified, and the high specific

Much work requires set to be done before we can have a sat factor rational basis for the treatment of the le ser ailments. Experience and experiment guide us to set all printers with atomic dispepsia to convers with hypertonic waters to send und dispeptites to the mildly alkaline saline springs, and to send the obese and the goult to the sources of strong waters, such as Carl-bad and Murienbad. After treatment with draftic eathersis, prolonged rest and judicious feeding are necessar. If the cannot be obtained then less herore measures should be used.

After all spa treatment a rest in a bracing climate for scieral weeks is strongly to be advocated before recommencing the routine of life

#### CHAPTEP XII

# PRACTICAL APPPLICATION OF COMBINED METHODS OF PHYSIOTHERAPY

## HAPPY LATON STEWART

## DISEASES AND INJURIES OF THE NEUROMUSCULAR SYSTEM

## CENTRAL MOTOR NEUROV LESIONS

Birth Hemplegas in Children—Birth injuries resulting in spisite paralysis and retarded mental development are treated best by prolonged and persistent reclucational gymnistics and missing. Simple arm and foot plasing coupled with controlled movements aimed at plasing the finger upon the correctly colored or numbered squares, are often used Exercises of balance and slow bilateral coordination are very vituable Progress then to very simple gimes within the mentil and physical power of the child to grasp and perform with reasonable scenaricy. Radiant light for ten minutes coupled with effecting and gentle muscle kneading ands in keeping up the nutrition of the affected parts. Accurate placing and controlled pressure with horse and fork are useful in preparing the child to serve himself at the tible.

Hemplegia Following Cerebral Hemorrhage —From ten days to two believes after the lesson has occurred or after there is rev on to believe all bleeding has stopped the use of through and through disthermy by the interpariet I route using 500 milhamperes of current of absolute stead interess will greatly and in hasteming the absorption of the clot. Take five minutes slowly to increase to maximum muntion this for twenty minutes and use three minutes in reducing at slowly to zero. On the affected part, use officurage on the flexors petrissage and efficurage on the extensors high frequency surface applications, or diathermy from hand to shoulder and foot to hip will and in relaxing the spatienty. Reedicational ever cies with slowly and carefully coordinated and controlled movements should be employed from the third week. Some very good results have been obtained with men at St. Elizabeth's Hospital at Washington and other places by introducing gumes such as indoor baseball and volley

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---- Die physiologischen Grundlagen der Hydrotherapie der Herz krankheiten, Zischr f phys u diatet Therap, xv, 1911 with slight effort, a rather wide range of motion on polished or smooth wooden urface (see Exercises with Carriage)

## LASSIVE EXELCISES

Normal movements of each m nn joint of the affected part should be carefully carried out. Extreme cution should be used not to overextend muscles or muscle groups already at a physiological disadvantage and



110 I -- PASSIVE EXTENSION OF SHOULDER JOIN

tending to be stretched by their less affected physiological opponents as is often the cise with the Tibialis anticus. Those groups tending toward contricture should be stretched system times to their physiological limit. The plantir and calf musch groups usually require this care

## EXERCISES WITH CARRIAGE

#### 4rm

Patient on chair affected side toward the table

- 1 Abduction and adduction of arm
- 2 Flexion and extension of elbow
- 3 Abduction and adduction of the arm with movement arrested at different points and starting a_un
- 4 Small circles to the left and to the right by combined movements of clow and shoulder
- J. Have the patient lean forward so as to bring the arm in the same plane as the body using large sweeping inovements from the shoulder

bill A surprising amount of motor activity is often regained and the patient completely forgets himself in his interest in the game. The sursoidal or furadic current may be sparingly employed to obtain muscular contraction and encourage the patient to voluntary muscular effort where active motion is impossible. Assistive movements should be stressed, insisting upon the consecous motor effort on the part of the patient, even though his response to such effort is almost nil.

Cerebral Degeneration—Impured bruin nutrition due to artenosclerosis may at the beginning be retarded and to some extent improved Cerebral dirthermy may be used by applying the electrodes to the forehead and occiput Gentle, long-continued cerebral galvanism through water resistance has all o been successful in treating these cases Allid, general massing, as a useful adjunct in improving general mixture.

fully graded general exercise is valuable

Encephalitis Lethargica—In the convolvement stage of this discretory of function may be historically massage and exercise, emploring general petrissage and efficurage General calisthenics and carefulling and exercises may be used

The spasticity of any muscle group is treated by radiant light and little frequency

Cord Lesions-Infantile Paralysis -After the acute stage has passed and all tenderness has disappeared from the muscles, persistent and lon,-continued physiotherapy is indicated A reasonable degree of success has been attained through treatment by the separate use of several types of physiotherapy, but it has been clearly demonstrated that the properly combined use of different measures is much more satisfactory Radiant light and regional diatherms are used to warm and prepare the part for massage and exercise The paraffin bath or whirlpool bath may be substituted for radiant light Diathermy or high frequency are invaluable aids in inducing the deep hyperemia which improves the nutrition of the muscles Massage should be confined largely to petrissage and be stimu lating in type, but not too long continued Care must be taken to direct the effort to the muscle groups The tluck, fatts, fibrous laver, which so often overlies the muscles, may receive the major portion of the effect of the massage, if superficially given Before voluntary motor responses are possible, the sinusoidal wave galvanic, or interrupted galvanic cur rent may be used In muscle groups supplied by partly regenerated neurons a fur response may be obtained by faradism, but the early insti tution of voluntary movement is especially desirable Muscular contraction by means of carefully graded exercise is, as a rule, to be preferred to that obtained by electricity If the age of the child permits, his active mental effort should accompany each passive movement, making it really assistive in type These exercises should at first be performed, as far as possible, in a plane at right angles to gravity A small block of wood upon which the hand or foot is strapped, supported by castors, will permit,

## RESISTIVE EXERCISES

#### 1am

1 Flexion and extension of  $tim_s\epsilon r_s$  resisted finger to finger by the operator



FIG 2-I ROTATION AND SUPPLATION MACHINE

- 2 With glove the fingers of which in counterweighted extension with hands prone, flexion with hand supine
  - . Finger flexion machine
    - 4 Finger treadmill

## W rest

- 1 Flexion and extension abduction and adduction resisted by operator
  - Wrist roller machine

## 474 COMBINED METHODS OF PHYSIOTHERAPY

- 6 Hand prone on carriage, abduction and adduction of the west
- 7 Hand with ultrar side on carriage, flexion and extension of wrist

## Leq

1 Patient supine, heel on carriage, abduction and adduction of the

- 2 Patient on unaffected side, unaffected leg flexed, internal mal
  - 3 Position same-flexion and extension of hip

## Free Exercises

# Arm

Patient lying supine on broad table or floor, exercises bilateral to improve coordination. Starting position, frands to the side

- 1 Bring hands on hips and return
- 2 Raise forearms to vertical and return
- 3 Carry arms to complete abduction and return 4 Raise arms fore upward, carry to above head and return
- 5 Carry arms across body and return
- 6 Bring hands sharply to shoulder and return
- 7 Carry arms to full abduction, bring hands to avilla by flexing elbows, extend elbows and adduct arms
  - 8 Supinate and pronate the forcarm

#### Lea

Patient on unaffected side

- 1 Flex and extend ankle
- 2 Flex and extend knee
- 3 Flex and extend hip
- Patient prone

Abduction and adduction of leg with knee semiflexed, rotate  $\mathop{\rm hip}\nolimits$  inward and outward

## Back and Hip Extensors

- 1 Patient sitting hands on hips incline trunk forward and risk to vertical Progression secured by increasing the degree of forward inclination of the trunk and by placing hands belind the section of the head
- 2 Patient prone on table, feet strapped, raise backward and lower Hands behind neek or extended over head increase the difficulty of this exercise

In summarizing the treatment of Infantile Paralysis the following points should be kept in mind Many spinal motor neurons not entirely distroyed may be stimulated to function veries after the acute attack Work on injured tissue of this type is a delicate task which should not be entrusted to the untramed The danger of overfatiguing these weak ened structures is constant. Exercic as nearly as possible active in type is better than electrically inducing contractions and both types should never be combined at one treatment. Two or three movements of each type are sufficient at first, and the mercase in amount should be very gradual indeed

#### PERIPREPAR NEIVE LESIONS

Muscle Nerve Testing - Reactions of nerve and muscle become greatly altered in their response to electrical stimulation when any pathological condition is present. Electrical testing supplies us with most of our data for diagnosis in nerve conditions and is a most important process. giving information that cannot be samed in any other way. The technic of nerve and muscle testing should be the roughly understood and con siderable practice is necessary before one becomes proficient

The faradio and interrupted galvanic currents in turn are used in to time both the muscle and the more that supplies the muscle. The nor mal muscle responds to faradism by tetanus, as the interruptions to this current are so continuous in character that the muscle does not have a chance to relax between stimult. When the motor nerves are affected by disease or traums they lose their normal re ponse to faradic current in fact, under certain conditions this current has no power to cvoke any response whatever The response to galvanic current however is a twitch produced when the current is made or the circuit is closed and a slighter twitch when the circuit is broken greatest at the cathode. Such are the normal reactions of nerve and muscle to these currents

The changes in response to electrical stimulation which follow trauma by cutting cru hing or pinching or inflummatory processes of the motor peripheral nerve or its sheath are termed reaction of degeneration. This reaction of degeneration or R D is characterized by

1 Lo s of faradic exertability

- 2 The following changes in the respon es to interrupted galvanism
  - a Respon e is sluggish and wavelike in character b The motor point is lost
  - The polarity response is inverted that is instead of the muscle twitch being greatest at the cathode when the circuit is closed or made it is equally great or greater at the anode change in, the normal formula ACC > ACC to ACC or

ACC > ICC

#### Elhom

- 1 Pronution and supuration, flexion and extension resisted by the operator
  - 2 Pronation and supination machine
    - 3 Flexion and extension of clow with puller weight machine



Fig 3 -Resistive Exercises for Development of Leg Stump

## Shoulder

- Operator behind patient, resisting abduction and adduction of the arm
- $2\,$  Arms rused forward, operator resisting and carrying of arms sideward and forward

## Leg

- 1 Operator grasps dorsum of the foot with one hand and heel with the other and resists flexion and extension of the ankle
- 2 Grasp with one hand above the knee and the other around the foot, resist flexion and extension of the knee and hip
  - 3 With grasp of the ankle resist abduction and adduction of the hip

In unmarizine, the treatment of Infantile Paralysis the following points should be kept in mind Mans spinal motor neurons not entirely destroyed may be stimulated to function veris after the acute attack. Work on injured tissue of this type is a delicate task which should not be entriested to the instraint. The danger of overfatiguing these weak end structures is constant. Exercise is nearly as possible active in type is better thus electrically inducing contractions, and both types double near be combined at one treatment. Two or three movements of each type are sufficient at first, and the increase in amount should be very gradual indeed.

#### PERIPHERAL NERVE LESIONS

Muscle Nerve Testing —Reactions of nerve and muscle become greatly altered in their response to el ctrical stimulation when any pathological condition is pre-ent. Electrical testing supplies in with most of our data for diagnosis in nerve conditions and is a most important processing information that cumot be gained in any other way. The technic of nerve and muscle testing bould be thoroughly understood and considerable purchete is necessary before one becomes proficient

The faradic and interrupted galvanic currents in turn are used in te ting both the invite and the nerve thris implies the mustle. The nor mil mustle responds to faradism by trainis, as the interruptions to this current are a continuous in character that the muscle does not have a chance to relax between stimul. When the motor nervies are affected by disease or trauma there lose their normal response to faradic current in fact, under certain conditions this current has no power to evoke may response whatever. The response to galvanic current however is a twitch produced when the current is made or the circuit is closed and a slighter twitch when the current is broken greatest at the cathode. Such are the normal respinse of nerve and muscle to those currents.

The changes in respon e to electrical stimulation which follow training be entiting, crushing or pinching or influmnatory processes of the motor peripheral nerve or its cheeth are termed reaction of degeneration. This reaction of deen neration or R.D. is characterized by

- Loss of faradic excitability
- 2 The following changes in the respon es to interrupted galvanism a Pesponse is shiggish and whethe in character
  - b The motor point is lost
  - c The polarity response is inverted that is instead of the muscle twitch I ring greatest at the cathode, when the circuit is declared or made it is equally great or greater at the anode changing the normal formula LCC > LCC to LCC = ACC or ACC > LCC

These changes begin in a muscle, the nerve supply of which is interfered with from eight days to three weeks after the injury or disease his occurred, and become progressively greater in degree. In the normal muscle the chronivie or contraction time is very brief and the muscle will respond to a stimulation of 1/2,400 of a second at 100 volts. Provessively longer and greater stimula are required if degeneration progress, until, with one lasting 1/200 of a cound, it may not be possible to obtain a contraction. The revision of degeneration is a sign of marked value to us in that it may induce the location of the lesson, and stage of its



Fig 4 -- Measuring the Strength of the Muscles Covering Elbow Expension is a Foreign Americation Case.

development R D is never present in a central motor neuron lesion. When there has been a continuou or cutting injury to some, but not all of the fibers, or they have been subjected to a mild amount of present, a condition known as purial reaction of degeneration may occur. This condition is characterized by weakened re ponses to farrid in a closer response to gulviums in a dulling of the motor point and a diminimition in the normal differences of polar re ponse. In the stage of regeneration, voluntary motion often precedes the return of firadic excitability and a gradual change to normal takes place during a period of months. The surgical indications for nerve suture neutroms or deal of cicatrical excision or freeing a nerve cought in callus must be followed if physiotherapy is to be effective in shorteum, the disability time.

Apparatus and Technic—The musch should first be tested with faradism, using a large indifferent and a small active electrode, care being taken not to use an unount of current which will "splash through to neighboring unaffected muscles. The corresponding muscles on the nor mal limb or on the operator may be used for control. The test with in terrupted galvanism is most satisfactory when done by means of the muscle testing condenser. This is a modification of the Levis Jones apparatus consisting of a series of galvanic condensers, of ascending microfrard capacity equipped with an interrupter on the machine. The current is delived it a stringth of about 100 volts which is sufficient to overcome the resistance of the properly moistand shin. A scale vary ing from 0.1 to 2 microfrards is available on this in whome

Some preliminary warming of the part is desirable before testing Radiant light and heat or the whirlpool or paraffin bath may be used for this purpose Diathermy, while aiding distinctly in the nutrition of the part and the regeneration of the nerve and muscle, will onthe badly mask the results of muscle testing hence it should be used after and not before such tests are to be made. With the use of the condenser. the normal side also is taken as a control. The active, testing electrode should be not over one-half meh in ditmeter and for the interesses and finer muscles must be even smaller It is attached to the negative pole and applied as nearly as possible to the motor point. One condensir after another is turned on and the point noted at which a good response in muscle or tendon is charted A convenient chart for recording results of the test, as used by Captarn A B Hirsh at Walter Reed Hospital is appended Oceasionally in large masses of sear tissue the motor point may be displaced, but it is easily located with the condenser. It was found at Walter Reed Hospital that the test made with the condenser checked up well with conditions found at operation. Muscles which respond somewhat to faradism will usually recover within six weeks but a guarded prognosis should be made in re, and to ultimate recovery

FARADIC GALVANIO

Musculocataneous Peroneus Longus

Muscles Extending Tarsus and Flexing Digits

Tibislis Posticus

Gastroenemus mner head Gastroenemus outer head Tibislis posticus

Flexor longus halluers

Flexor longus halluers Flexor longus digitorum Flexor brevis digitorum

Interesses

Name Ward

Fested by Recorded by

Diagnosis Department No Remarks Date

#### FARADIC GALVANIC

## LP LE

Muscles Acting on Humerus Superascapular

Suspra pinatus Infraspinatus

Mu culocutaneous

Circumflex Di Itaid

Teres minor

Muscles Acting on Forearm

Musculor utaneous Bicens

Musculospiral Supinator longus Triceps

## Muscles Cansing Propation

Median

Pronator teres
I ronator quadratus
Muscles Causing Flexion

Flexor carps radialis

Palmaria longus Flexor sublimia digitorum Flexor longus políticis Abductor políticis

Ulnar

Flexor carps ulnaris Flexor profundus digitorum Hypothenar group

Flevor brevis policis (median)
Adductor policis

Muscles Causing Extension Musculospinal

I stensor carpi radialis lon or Extensor carpi radialis brevior Extensor ossia meticarpi policis Extensor longus policis

Fxtensor communis digitarum I xtensor carpi ulnaris

Muscles Acting Between Fingers Ulnar

Intere ser
(2 Outer Median)

## Muscles Atting on Femur

Ohturator

Adductor longus
Adductor magnus (sciatic)

Gracilis
Superior Glutcal

Tensor voging femoris Musiles Acting on Tibia Anterior Crural

Vastus internus Vastus externus Sciatic

Breeps Semitendinosus Semimembrano us

Muscles Flexing Tarsus and Extending Digits

Anterior Tibial
Tibiahs anticus
Extensor longus digitorum
Fatensor proprius hailucis

Electrical Diagnosis at Operation—Grains and Ingliam used electrical testing during operations at the Cape May and Fox Hills Army Hospitals to identify and determine the condition of exposed nerves. The nerve was pieled up on a carried glass and and it stell with only sufficient strength to produce a minimum mu cle contraction. Tests were made above and below the lesion. Information of great surgical importance may be obtained in this manner.

Treatment of Peripheral Nerve Injuries -- Great care mat he ear cised not to overstimulate regenerating nerves -- Our efforts should be directed to maintainin, as far as possible the nutrition and tone of muscles whose nerve supply has been interfered with. Padrant light and heat and gentle massage are useful in this respect. Treatment by means of dividering which as before tated, interferes with muscle test mg is a most vilutible part of the ragim. It is now believed that a good deal of the streply which ensures in muscles whose nerve supply is subnormal is due not to mactivity but to overretivity caused by a fibrillation of the individual muscle fibers. In several cases of severe peripheral neurities due to ben'leri this fibrill ition wis course enough to seen. The effect of the high frequency currently particularly the



FIG 5-APPARATUS FOR MEASTRING DEGREE OF REFURY 1 JOINT FUNCTION

d Arontul in producing edition and are ting thrillation is marked. It is perhaps as much through this effect as that of lo it vasiodilatation that dathermy has proved so useful in these conditions. The electrical stimulation of contraction has often been overdone and a carefully graded tochnic such as that used by Sampson and described in the ection on Sinusodal Currents is all that should be used. Overstimulation will defect the sim of critis regeneration and delay recovery.

Passive motion should be maintuned in all the joints moved by the affected muscles and protective braces are es ential to prevent contractures. Progress to assi tive and active exercises as returning enervation permits. Carefully pre-cribed occupational therepy should be used controlled with physiotherapy as soon as some active motion and strength are sourced.

#### FARADIC GATALNIC

#### L P L R

Muscles Acting on Humerus Superascopular Susprasminatus

Infraspinatus

Musculocutaneous

Circumflex Deltoid

Teres minor Muscles Acting on Forearm Musculocutaneous

Bicens Musculospiral

Summator longus Tricens

Muscles Cansing Propation

Median Pronator teres

Pronator quadratus Muscles Causing Flexion Median

blexor carm radiaba Palmaris longus Flevor sublimis digitorum Flexor longus polheis

Abductor pollicis Illnar

Flexor carpi ulnaris Flexor profundus digitorum Adductor pollicis

Hypothenar group Flevor brevis pollicis (median) Muscles Causing Extension Musculospinal Extensor carm radialis lon ior

Extensor carpi radialis brevior Extensor ossis metacarni pollicis Extensor longus pollicis Extensor communis digitorum

Lxtensor carm ulnaris Muscles Acting Between Fin.ers Illnor

Interesser (2 Outer Median)

Muscles Acting on Femur

Obturator

Adductor longue Adductor magnus (sciatic) Gracilia

Superior Gluteal Tensor vaginæ femoris Muscles Acting on Tibia

Anterior Crural Vestus internus

Vactua externus Scratic

Bicens Semitendinosus Semimembranosus

Muscles Flexing Tarsus and Extending Digits

Anterior Tibial

Tabialis anticus Extensor longus digitorum Extensor proprius hallucis

Electrical Diagnosis at Operation —Craus and Incham u ed electrical testing during operations at the Cape Max and Fox Hills Army Hospitals to identify and determine the condition of exposed nerves was picked up on a curved glass rod and tested with only sufficient strength to produce a minimum muscle contraction Tests were made above and Information of great surgical importance may be obhelow the lesion tained in this manner

Treatment of Peripheral Nerve Injuries -Great care must be exer cised not to overstimulate regenerating nerves. Our efforts should be hould be placed along the affected side of the lower cervical vertebre, the other may be a cuff above the elbow or the autocondensation handle held in the hand depending upon whether or not the pain radiates below the elbow. The electrode for Morton wave is applied along the upper lorder of the trapezius muscles to include the exit of the erreumflex nerve. State bru h and sparks may be used freely over the entire painful area

Sciatic Neuritis—The technic of the electrode application for ionization or positive galvanism is described under ionization. The radiant light should be applied from the searum to below the time. A long narrow electrode extending from the sciatic note to the poplitical space is used for the Morton wave application while sparks are applied throughout the origin and course of the search nerve. There is a steady progression in the vigor of the triatment from the subscute through the chronic stage Chronic cases are often temporarily rendered acute after which they clear up more readily and the pittent should be so informed.

Neurasthenia — The number of diagnoses of pure neurasthenia is dicreising. Some organio basis for the symptom-complex termed "neurasthenia is now usually found and yet whatever the cause there are certain tonic treatments of a physical type which will in most cases hasten recover. Those cases associated with low blood pressure are treated by static charge spanil vibration microssingly rigorous missage and general overcises. There has been discribed a splanching type in which due to poor vasomotor tone of the splanchine vens the systolic blood pressure is higher in a horizontal than in a sitting or standing position. These cases seem to be benefited by the type of treatment just given and an improvement in their general condition is consident with a return to normal in the blood pressure variations in the different positions of the body.

In cases complicated by anomic and sing-sh intestinal action, general progressive body raving with the ultraviolet lacht and special abdominal massage, and evercises with Morton wave current over the liver are indicated.

The tone type of hydrotherapy especially short cubinet bath followed by Scotch douche with increasing variation of hot and cold is very useful. It is justinable to employ the psychical effect of the electrical modalities, when carefully chosen as well as for definite physical effect.

Tokie Myositi —In the acute stage rehef is obtained by prolonged local heat, radiant light of high candle-power or superheated dry air followed by direct diathermy or surface high frequency static effluwe or mild state sparks and Morton wave with massage consisting of petrissage and gentle deep kneading

In the chronic stage disthermy should be pushed to telerance. Long heavy sparks and Morton wave or the long stroke motor vibrator should follow disthermy. A surging sumsoidal current may be to some extent

Neurona — The warm whirlpool or paraffin bath, diathermy, sud occasionally, positive galvanism, are useful in allaying pain. The cure of it is distinctly a surgical problem.

Neuralgia—Prolonged intense radiant hight and heat, distherny localized over the affected nerve and static effluxe will often relieve the condition. All treatments should be long continued and gentle in type

Volkmann's Contracture—Good results were obtained in many of our army cases by the persistent use of physiotherapy. Radant light and heat or the whirlpool buth, is not as could be borne, were used for about ten minutes followed by zone or through and through distheray. The massings should consist of effluence, he ht kneading and passive more ments. The fingers should be stringlitened with the wrist flexed and held in this position while the attempt is made to extend the wrist.

Acute Neuritis —In either the toyle or triumatic type of acute neurits, a good general technic is as follows. Radiant light and heat, 1,500 cmille-power for twenty minutes. Direct or zone dathermy 1,000 to 1500 milliumperes for twenty minutes followed by ten minutes of static efficient fit ender points are found, the diathermy and static brush should be localized as nearly as possible over them. Special care should be taken in going over the spiral nerve roots which supply the affected area to elect tenderness.

Snow uses static Morton ware, starting with a short, easily tolerated spark gap which is widened as further tolerance is developed. In my hands this procedure has occasionally been very successful but often has increased the severity of the pair.

Another technic, employing ionization with sodium salicylate, has been

described in the section on that modality

Frank B Granger, of Boston, has attained good results with a combination of prolonged ionization or positive galvanism, together with what tion to numbiness of the affected spinal nere roots. In this technic the solid rubber ball vibritede is applied to the intervertebral spaces on the affected side, at least one minute over each nervo root. If too short a vibration is given, the tendency is to stimulate instead of to numb the

Static sparks may be used to relax associated mucele spasm but are

more valuable in chronic nenritis

Chronic Neuritis—Prelmunary heat and diathermy should be followed by static Morton wave and sparks, after which slow deep efficiency along the nerve trunk for several munites should be given. Sparks of sinusoidal current may be used freely to rehieve the spasticity of neighboring muscles. I contaction and positive gravanism are not as efficient in chronic as in acute neuritis.

Brachial Neuritis —Radiant light and heat should be applied to the nerve roots as well as to the shoulder and arm One diathermy electrode

## Fractures -- The treatment of fractures has been mentioned as one of the exceptional conditions in which the usual inreacal procedures are modified when physiotherapy is applied. This is in reference to the retention of fixation apparatus. The bet results are obtained when open fixition or bivalred casts, which may be carly removed and replaced are used There is always triuma to the surrounding soft parts to which the application of physiotheraps is highly desirable while the continued mobilization of surrounding joints is an esceptial feature of go d frac ture work. The actual health, tung of the fragments them clyes may be reduced fully one-third. In cases of delived union latting many months. callus has been, for the first time thrown out after the use of physic therapy Complications such as a termicilities may usually be effectively treated. Far better results follow a require of preoperative physics.

therapy after extensive injury to soft tissue where an open operation is nece situted. John I Morchead of New York emphysizes the use of massage the day following reduction and presic motion instituted as oon

as possible after the third day Simple Fractures -Radiant haht and heat is an aid to nutrition and to the rulef of pun and may be started immediately with gentle effential These two me some share been extremely useful where prin and mustle spism rendered reduction difficult. Very short tatte sparks and effluve may be emplified for the same purpo e. As one as all ten dence to capillary coring has exact a through and through seditive duthermy technic should be used. This consists in givin, about 500 milliamperes for forty minutes daily. Zone disthermy thin milliam timelity fitting and undivided east may induce increased welling and symptoms of pressure. It may be used above and below a splint or loose east, but the direct method is to be preferred where possible. Static effline is useful in relieving both pain and swelling. With the friements firmly supported gentle passive motion of the joints above and below the frac

As soon as callus runon as obtained more vigorous ma sage ancluding deep petrissage and fraction should be used Active motion is one of the most valuable me sures and must be started at the carbest possible mo ment Distril pants should be settled exercised from the fart Colonel Dean in his work with the Briti h Arms demonstrated the great value of active exercic Should joint adhe ions form the u e of the patient's body weight may often be employed to stretch them instead of depending upon the manual passage exercise. The breaking up of adhesions by 110 lent passive motion under an anesthetic is almost never necessary or advisible

ture should be started early and continued until active motion is possible

substituted for static. Massage includes trapotement, deep friction and kneeding the object of these procedures being to relax the muscle span and mechanically remove the necumulated toxins. Fiffort is made to in stitute a greatly increased active hyperemia and their force the excess circulation out of the muscles, bringing about a complete change of circulation and depleting the toxins and destruss.

Traumatic Acute Myositis —These injuries are typified by the small mig immede bruises received by football players and the ramarkable efficiency of early and paissistent physiotherapy has been demonstrated in

a very large number of cases

The treatment of mild injuries without much terring of muscle filers, should be begin it once or within a few hours. Fifteen hundred endle power rid in It halts, prinfill bith, steam towels, superheated dry air or bot water may be used for external heat, mentioned in order of prefixences. Direct through and through diretterms, 1,500 to 2,000 mild imports for fifteen inmutes, should be followed by Morton was take spirks on gentle slow, sum oddl contractions of the involved muscles It is of the greatest importance to remove the evadate from the muscles before it has bed in opportunity to organize

Tre timent of severe brusses which are associated with tears of the muscle fibres should be postponed a few hours, until all capillary bleed may have ease. The Morton wave or sparks should be given very guilty, if at all on the first day. Mas are should be directed the first day toward clearing out the lymphatics proximal to the lesion and not out the torn muscle fibers. The second and thard treatments should be quite

vigorous in regard to these measures

Torn Muscle Insertions—These impuries follow sudden violent ever tions, such as those used by the sprinter. The muscless must be completely relived in extrasion before the application of physiotherup. Fiterial heat, direct or modified diritherms, by the combined use of subconderse tion cushion and surface non-venum electrode may be applied. States efflive is a limble in releving prim and gently depleting the it sue fluids. No other type of static or contrictile current of any kind should be used until the muscle attachment is again secure. Gentle, long-continued effluic will relax spasm, alley such pain and remove lymphatic stasis.

Tenosynovitis—This condition is most commoily found in the Achilles' tendon but sometimes elsewhere. Acute cases require absolute rest and superincial heat, of the kinds mentioned. Powerful ridiant light or par-fin latth are best, or static effline and tmy spirks, followed by finger tip effluringe mit be used. In chronic cases, the local heat should be intensified and longer spanks or why turn may be used to free adhesions between tendon and sheath and to break up and absorb any or, mixed could to that may be present. Further massage consists of frictions and effline.

Fractures -The treatment of tractures has been mentioned as one of the exceptional conditions in which the usual surneal procedures are modified when physiotherapy is applied. This is in reference to the retention of fixation apparatus. The liest results are obtained when open fixation or his alsed casts which may be early removed and replaced are used There is always trauma to the surrounding soft parts to which the application of physiotherapy is halds do urable while the continued mobilization of surrounding joints is in escential feature of good frie ture work. The actual health, time of the fragments themselves may be reduced fully one-third in east of delayed umon lasting many months. callus has been for the first time thrown out after the use of physictherapy Complications such as a teamveletis may usually be effectively treated For better results follow a regime of preoperative player therapy, after extensive injury to the tribute of open operation is necessitated. John J. Morrhead of New York emphasizes the use of massage the day following reduction and passive motion in tituted as soon

as possible after the third day

Simple Fractures -Padrant haht and heat is an aid to nutrition and to the relief of pain and mix be stirted maniculately with gentle efficurage. These two mersures have been extremely useful where pain and mu cle sparm rendered reduction deficult. Very hort statue spirks and offluve may be employed tor the same purpose. As soon as all ten dency to capillary coring has ecised a through and through sedative disthermy technic should be used. This consists in giving about 500 milliamperes for forty minutes duly. Tone disthermy this ugit a tightly fitting and undivided cast may induce increased swelling and symptoms of pressure. It may be used above and below a splint or loos cast, but the direct method is to be preferred when possible. State efficie is useful in relieving both pain and swelling. With the fragments firmly supported gentle pa ave motion of the joints above and below the frac-ture should be started early and continued until active motion is possible

As soon as callus union is obtained more tigorous missign including deep petrissige and friction, hould be used. Active motion is one of the most valuable measures and mut be started at the earliest possible moment Distil joints should be actively exercised from the start. Calonel Dean in his work with the British Arms demonstrated the great value of active exercic Should joint adhesions form the use of the patient's body weight may often be employed to stretch them unstend of depending upon the manual passive exercic. The breaking up of adhesions by viobut passive motion under an anesthetic is alm at never neces ary or advisable

In fractures near or into joints early mobility is being increased insisted upon. When, however, this is not possible, the muscle tone may be maintained by the use of the slow sunworded, faradic or galrame ware currents. Very gentle contractions may be produced in individual muscles which will not involve joint movements.

Exuberant callus may be absorbed by the use of short intensive diathermy treatments. Use small plates and push the heat to tolerance Great care mu t be taken if the area is anesthetic. Frictions and wha

tions are additional aids in callus absorption

Compound Communited Practures—This type constitutes a very large group in our arms practice. The cirtle use of prolonged radiant light and ultraviolet light directly on the wound is very valuable in controlling the amount of infection. Diatherms should be used by the double cuff method from the start. Slight motion of the fragments, produced by treatment, may not be detrimented. Later on, persistent smuss may be treated directly by ultraviolet light with the water-cooled lamp through the use of sinus applicators. Massage has often brought to the surface a small and unsuspected sequestrum and it is useful for mercasing, tassee drainage when cutth applied.

Fractures in children complicated by rickets are treated by local and general ultraviolet light in addition to the other forms of physiotherapy

Fracture Sprains—The linear fractures and small separations of bur tubercles that occur so commonly with sever, aprins are better protected but otherwise treated by the technic for sprains later to be described. Where possible early active movement should be insisted upon.

Rickets—If there is one specific use, in phy iotherapy it is the not of ultraviolet light in this condition. The work of Hess of New York, Erlacher, of Vienna, and many others shows that this method of treatment alone is sufficient to cure a large majority of the cases. Heliotherapy unfiltered through plass may be substituted for the quartz light. Treat ment should be given dully to helf of the body, the initial dose depending upon the type of lump and individual skin reaction, by the principles already outlined. The average dose is one to three minutes at thirty inches, with a ten to twenty second duly increment. Periodic X rivs should be taken to estimate the degree of calcification. Two months is usually sufficient for restoration to a practically normal picture, in cases not too far advanced. Where quartz light is not available, heliotherapy should be substituted and radiant hight and massage may be used in conjunction with the changers in det and medicinal care.

Osteomyehtts —The work of A B Hirsh and C M Samp on, at the Fox Hills Army Hospital, demonstrated the value of disthermy and ultravolet light in all types of osteomyehtts The through and through dathermy, with technic arranged to concentrate the heat in the sweets area, is the best type, where its use is possible The double cuff or cuff

and water method may be u ed where the direct double plate technic is impossible. The active hyperemia induced in the seat of the lesion is a powerful aid in arresting the infection. General ultraviolet light should be used, preceded by high candle power irradistion to increase the skin capillary hyperemia, thus angineating the volume of the blood stream acted upon by the rives, for the purpo e of huilding up the general resistance. Local applications of quartz hight are given if the location of the infection is fairly superficial. A large surface quartz applicator is used with compression. Deeper seited lesions with discharging sinuses may sometimes be reached through special applicators with the water cooled light.

Tuberculous Osteint —General ultravolet irradiation is always in dicated in tubercular bone disease. Local applications are useful if the lesion is sufficiently superieful to be reached by compression. The employment of distillering will increase the phagocetes where most needed and its method of application depends upon the location of the proces-

Pernatitia—Sumple pernastitive treated with radiant light and heat or pyraffin hath followed by high frequency state effitive and gentle effectiving. When pernastitus is compliated with spir formation as is common in the or calcus the inflammatory process and consequent dissibility may be greatly relieved. Occasionally, nearly formed spiris may be to some extent absorbed. There is often little correlation between the size of spiris and the physical dissonifort they produce. Intensive external heat is used if the process is superficial. If deep suited give direct disthermy with heat localized by using a small plate over the lesion Static sparks sometimes greatly relieve the pain and are used after disthermy.

Traumatic Arthritis —This type of injury is especially amenable to training by physiotherapy. In the acute stige where there is practically no rupture of ligaments seture hisperenius may be induced by the hot paraffin or whichpool bath strong radirant light high frequency or duthermy. This should be followed by static spriks directed not only around the joint surfaces but to such museles as may be in a state of protective spasin proximal to the sprim. This is followed by prolonged gentle massage employing for the most part frictions and efficiency curred well above the impured joint.

Active use of the joint protected against stretching of the affected higaments, is indicated from the start. The results of thorough and immediate treatment by this technic are extremely satisfactory. In severe sprains associated with extensive locaration of higaments intensive local external heat is indicated followed by state effine and gentle efficienting the main effort being to clear out the lymphatics above the sprain thereby mereasing the tissue draining. The econd or third day direct dathermy may be employed using plates of different sizes to localize the heat in the

torn ligaments, while gentle frictions are begin directly over them. Passive and active motions are used to an increasing degree, applied in such a way as not to bring tension on the torn structures. After several days, static sparks may be used around, but not over, the affected hea ments \ \ \asomotor \stimulation, by plunging the foot alternately into hot and cold water, is a useful stimulant Where there is excessive effusion into the joints the Morton wave for about twenty minutes should be given, followed by sparks. In the case of the knee, a blunt U shaped electrode may be applied so as not to include the patella. This procedure has often been so efficient in removing non-hemorrhagic fluid from the joint that aspiration was unnecessary

Toxic Arthritis - Symptomatic relief and temporary improvement may be secured by treatment before the focus of infection has been elimi nated, but the results are naturally greatly accelerated afterwards. Where persistent search has revealed no source, long continued treatment will often completely clear up the local point manifestation. The patients hould be warned of the temporary exacerbation of the joint condition which often tollows removal of infected tousils or teeth. After such removal accelerated recovery is the rule

The technic used consists in superficial heat by means of radient light, superheated dry air or paraffin bath, direct distherms, static Morton wave and sparks and mas age, largely offleurage A hydrotherapeutic application of hot whirlpool bath followed by cold pressure douche has

been used Relative rest of the joint is indicated

Arthritis Deformans - This condition has proven resistant to all types of therapy and yet under modern attack is by no means a hopeless The accepted conception of the etiology requires that the phy iotherapeutic treatment be directed both at the chiminative mechanism and the joint symptoms. It has been the rule that those joints involved for a period of not over a year yield rather readily to intensive treatment The dictary regulation search for focus of infection and correction of the entire regime of the patient, must be attended to with more care than is necessary in most other conditions

General body irradiation with the air-cooled quartz light, static wave over the liver, and deep abdominal massage and exercises should be given while the local conditions are being treated. The affected joints are treated by 1, 00 candle power radiant light, paraffin both or other local heat with high frequency pushed to tolerate, or disthermy If several joints of both upper limbs are involved, an autocondensation handle may be used from both d Arsonval termin ds Missage -largely frictions and effleurage—or mechanical vibration are used Static sparks are useful in the cirly stages of joint involvement

This has the appearance of being a 'shotgun prescription but each modality is aimed at a perfectly definite indication. Where it has been futhfully followed out, the results have been almost uniformly to arrest and improve the condition

Goat—In the veute stage no measurable effect can be produced on the constitutional symptoms. I ocally intense radiant light partifin or whirlpool lath reheves the local pain. W. J. Turrell has obtained good results with disthering but cells attention to the first that an exacerbation of the general symptoms often follows intensive local distherms due, he believes to reabsorption and the deposits from the involved joints. A good technic for the application of distherms is with the patient prone, his toes in saline containing one ele trode the other electrode applied as a cuff above the suble. State bresh and small sparks following local hert will relieve puin and histen absorption. Positive galvanization has hen need in the chronic stage. Here too static sparks may be used to tolerance following the application of local best.

Infectious Arthritis—This typ of arthritis as typified by genococcil infection, has shown limitation both of the disability time and in the amount of joint distriction in a terr large number of ca es in one of our Marine Ho pitals. We used in this group, the following technic In joints very acutely tender where minipulation or the slightlet pressure was subcarable very prolonged radiant light was applied to the entire triemfurence of the joint. In led case the 100 candle-power light on a stand was fixed some thirty in his from the patient and applied for a number of hours. In the subcaute stage intensive through and through direct districtions—We used about 1500 milliamperes for forty minutes. The procedures is rather reddit destroyed by high tem pratures and it is believed that 10th radiant light and distriction of hours. The procedure is rather the distriction of the stage of mampitation of the valued should be employed in this street is more sedative than distriction times to more sedative than distriction than districtions.

In the chrome stage mit age consisting of frictions and efficiency, and active and passive motions are used with increasing vigor. There was not available a state machine in this group of caves but in others it has been used in the chrome stage in the form of sparks with consider able success. The efficient suseful also in the subscute stage.

Tuberculous Arthrits—This presents a omewhat different problem Applications of intensive radiant light and dividently are here coupled with general and local irreduction is ultravolet light. Local treatment is given with genite compression only ever those affected joints which are furly superficial. The general treatment should be pushed as first as tanium, will permit, dividing the body into two segments front and back, in those who the incredits and four with those who do not After

maximum irradiation of about twenty minutes daily has been reached and continued two or three weeks, it is advisable to reduce the time to five minutes and with one minute daily increment work up to maximum and repeat

Bursits—In the acute stage, radrunt light and heat, through and through diathermy or surface high frequency are followed by state effure. In the subacute and chrome stage, static sparks, Vorton ware and fre-tional massage are added. Pas we exercise of neighboring joints should be used from the start. Active movements should be in tintied outly in the subacute stage and increased to full range, as soon as decreasing pain permits. Bursa, esting a dense shadow by X ray have returned to normal after several weeks of treatment.

Combined Conditions—It is quite usual for both towe and traumate inflammation in the main joint regions to find more than one to unvolved in the process. It may be the joint and burke only, or nearby nerre trunks and muscless may at o be affected. The diagnosis is usually made according to the structure which is mot involved in the inflammatory process. The treatment is somewhat similar and its minor varieties are determined by the main indications as given for the e-conditions, separately considered.

## DISEASES OF THE CARDIOVASCULAR SYSTEM

Rypertension and Arteriosclerosis—In simple hypertension aubconden ution has proved of value. To obtain good results the use of a well-constructed autocondensition matteres and the larger type of behir mide machine are essential. The small, folding electrodes and heat portable type of apparatus will not give satisfactory results. A careful record should be kept before and after each trainment. It has been the rule to secure, a temporary reduction of systolic pressure of the rule to secure, a temporary reduction of systolic pressure of the tween S and 20 mm. Hig between the beginning and end of a sin let welveministe treatment. The pressure reading will generally a turn to within 2 to 5 mm. Hig of the former reading before the next treatment leaving a small permanent gain cut time. Both the reduction secured during the treatment and the amount of not guine reduction secured during the treatment and the amount of not guine reduction secured during the treatment and the amount of not guine reduction secured during the treatment and the amount of not guine for that individual is approached. It should be stated that Turrell and one or two others do not believe that a permanent gain cut be secured by means of autocondensation. The average degree of improvement tated however, is the result of personal experience and that of main others in this field.

The initial conse of the hypertension remaining there is a con tent

A systolic range of from S to .0 millimeters of mercury is quite usual in hyper tensives without and treatment chateser or under varied forms of treatment - Entrea.

tendency for the patient without treatment to return to his former condition Generally speaking, the hypertension may be kept down, after it has once been reduced to approximately normal by periodic treatments. varying from one week to two months apart in different patients

The nationt is placed in a reclining position on the autocondensation mattress, attached to one pole of the d Arsonval current A steel cylinder or non vacuum autocondensation rod is held lightly, but firmly, in both hands The hands should be held free from the body by placing a small pillow beneath them Better results follow the application of the cur rent for twelve to thirty minutes at 00 to 800 milliamperes, than in stronger amounts or for a shorter length of time

Another quite satisfactory technic is a combination of body-cabinet radiant light boths for ten to twenty minutes followed by a warm shower. tab or mild Scotch doughe Body exposure in the reclining position to superheated dry air for one half to one bour, followed by several hours of rest in bed, after the technic of Byron Sprague Price of New York has also secured good results. The application of surface ln. h frequency alon, the spine is recommended by one but its effects are not as efficient as those obtained with autocondensation or hydrotherspy A_ain the reader is reminded that all types of static particularly brush and charge are contra indicated in any marked degree of hypertension

Arterio-clerosis with its associated hypertension is a much more difficult problem For the adequate supply of nutrition to reach the tissues through thickened blood vessel walls a certain amount of hypertension is essential If this tension is lowered too quickly or to too great a degree dizziness, weakness and other unpleasant symptoms occur. While it is true that, with real sclerosis by pertension does not come down as quickly or as fir as in the simple type I have several times seen it reduced below this level of safets

Autocondensation therefore should be used with extreme care in an attempt to lower the blood pressure somewhat at least to below the point of immediate danger from cerebral hemorrhage. Keep careful track of the patient's general feeling and condition as well as the pre-sure find ings, making no attempt to reach the degree of pressure considered normal for the pitient's age Occasional cases will be found in which the pressure cannot be lowered, and some cases have been reported in which there was an apparent rise following treatment Light general massue con sisting of efflenrage and petrissage and mild general evercises are indicated for their general effect upon metabolism. Sedative biths simple acrated or medicated may also be employed

Hypotension -- come phases in the treatment of this condition have been discussed in its common association with neurasthenia Static charge, spind vibration general ma sage and graded exercises increasing in vigor, have a distinct effect in raising systolic blood pressure. The tonic contrast, Scotch douche, especially to the spine, increasing the variation of temperature, will often accomplish the desired result

Phlebitis -- This is one of those conditions in which the intense pair is difficult to allay with ordinary medical and surgical procedures. Not being ambulatory, there are few cases reported in physiotherapeutic litera ture. As before mentioned, this is one of the few conditions in which disthermy has been named as a contra indication by most writers. The results attained by its use, however, in a number of recent cases, has led me to doubt whether there is any real contra indication to the employment of this modality Radiant light from an ordinary hand limp, with or without the stand, applied to tolerance directly over the affected vens, is distinctly analgesic. We have followed this application by diatherms given by the double cuff or plate, or the zone method, used above and lalow the affected part The superficial or ed e effect of disthermy so applied is of distinct value. In inflammation of the internal saphenous voin the commonest site of philabitis, a flexible, metal plate electrode is placed on the inside of the thigh, the other on the inside of the ankle, and about 500 to 1,000 milliamperes of current are given, for from twenty to forty minutes. The relief from pun in these cases has been very marked, and it is difficult to see how there is any danger of producing embolism. No manipulations of any kind should be employed in any stage of this disease, preceding organization

Endarteritis Obliterans -It is probable that we have at hand no means of curing this condition It may, however, be retarded and ar rested, for a time, by the use of physical measures. Any degree of arteriole and expillary dilatation obtainable will allow an increased amount of serum, rich in nutriment, to pass through into the tissues Such super ficial dilatation can be secured by the whirlpool bath, paraffin bath, etc Dilatation of the deeper espillaries is certainly obtainable by direct diathermy As a rule however, in these conditions, some modification of zone diathermy technic must be used Occasionally diathermy increases the pun It is not sife or advisable to give more than 1,000 mills mperes The so-called vasomotor gymentes, obtained by the use of contrast baths, or the contrast Scotch douche, are also beneficial

Anemia and Chlorosis -It has been stated before that the effects of physical agents, especially light, on the blood count and hemoglobin per centage have varied in the hands of different investigators. The predominating opinion is that improvement follows where heliotherapy or quartz light and general tonic treatment are employed

Heliotherapy, where the chimate permits, is administered by direct exposure of the entire body to the unfiltered rays of the sun, beginning with fifteen to thirty minutes and progressing to from one to three hours, as tanning permits The average daily increase in time is five to ten minutes

Ultraviolet light, when available is a more certain aid. The anterior and posterior portions of the budy may be exposed on alternate days or in those who tan poorly the chest back and the anterior and posterior surface of the extremities may be irradiated in turn. The air-cooled lamp is used. The initial distance is thirty inches with the mercury tungston and eighteen inches with the all mercury burner. The average time is a minute and a half, with ten seconds daily increment with the former type of burner and three minutes with a fifteen second increase when using the latter type I missimum time of thirts minutes is suf herent maintained one week. It is latter then to drop back to 20 per cent of the dose and repeat

The tonic hydrotherapy with fau douche general massage and ever graded exerci es are wailable adjuncts to phototherapy in the treatment

of this condition Organic Valvular Lesions of the Heart -In the section on the physiology and therapeutic application of exercise the behavior of the normal heart under exertion and the use of evert e in training the nor mal heart to maximum efficiency nero discussed. The work of Hulson Barringer and Wilson of New York, on the exercise tolerance of children with organic heart disease has done much to allay the fear of its employ ment in these conditions and still further at points to exercise as perhaps our most potent therapeutic anent in the treatment of the e conditions. It is the consensus of opinion of these writers and also of others that heart failure in organic disease is practically never due to physical exertion but to reinfection. Their combined work covers several hundred cases subjected to graded exercise and there has been improvement in nearly every CIEC

The heart working against organic disadvantage compares well with the normal heart in its tolerance to exercise unless its rights power is low Several types of exercise test and regime were employed (1) Walk one hundred yards on level ground in two minutes (2) Climb stairs with ten foot ri e in twenty seconds. A simple test available anywhere consisted in swin_in, two iron dumb-bells from overhead to between the fect and returning at the rhythm of thirty times a minute. The dumbbells u ed weighed from two to ten pounds each and this exercise was repeated ten to forty times starting with the lighter weight and the lesser number of times and gradually increasing the severity of the exercise

The points to be noted on judging the effect of exercise are

- 1 The appearance of the face, as regards flushing and signs of fatigue and strain
  - 2 The respir thon
    - The time required for the pulse to return to normal
  - 4 The systolic blood pressure rise



Functional Cardiac Disturbances - In our Army Hospital at Lakewood New Jersey, and at Walter Reed Hospital in Washington, a very large group of cases of this type were treated. They were variously classified as tachycardia or effort syndrome and were similar to those classified 'D A H of the British Army The work at Walter Reed under the direction of the chief aide Mary McMillan, and her assistants, has been reported in detail by Lt Col Burt W Carr, now Supervisor of Thysiotherapy for the U S Veterans Bureau These patients were treated with systematic graded exercises largely of the rhythmic type



FIG 6-CARDIOVANCULAR CLASS IN ARMY HO PITAL

checked up with constant observation and blood pressure and pulle find ings. The list of exercises was divided roughly into five groups

- 1 Passive and assistive exercise generally in the horizontal position
- 2 Active slow rhythmic maximents prone or standing
- 3 Active movements with coordination
- 4 Active movements including both speed and coordination
- Walking rinning and indoor ba eball and other light games

The patients were thoroughly examined and assigned to an appropriate grade of work. In case of any doubt they were placed in the next lower grade Those admitted to Grade 1 were as a rule under nervous tension with high pulse rate and very apparent effort syndrome. The excreises were given in slow rhythm as setated with respiratory movements and given in a low and monotonous tone of voice Frequent rest periods with complete relivation were taken. Careful examination was made upon

Barringer states that a rise of 20 mm. Hg, without other indications of strain, is a favorable sign and emphasizes the fact that no exercise other than string up should be attempted for a week or ten days after an acute attack his ceased and the temperature his become normal. Hal sey concludes that graded exercise may be given to children with organic heart disease, improving the action of the heart.

In a large group of cases, Man G Wilson made some interesting observations on the exercise tolerance of children with a variety of cardiac defects, comparing them with the tolerance of the normal children. The

results of her tests were as follows

Tolerance to excruse is roughly grouped as good, fair or poor

Tuelve with concenital malformations-all good

Thirty six initral insufficiency—twenty three normal, thirteen fair

Twenty mitral stenosis-twelve normal, eight fair

Two with aortic reguration and mitral stenosis—both normal

Six with chronic valvular insufficiency—poor, improving steadily with exercise

Nincteen with apical systolic num murs—eighteen normal, one poor.

One hundred and system organic cases under treatment—three died,
one with tuberculous complications and two from acute myocarditis following toushitis.

Other forms of simple graded exercises would undoubtedly attain in the results. These are the types of eases in which it has been quite the rule to proscribe all exercise. The value of exercise in organic best diesse, especially in the young should not longer be in doubt. Certainly exercise should seldom be proscribed in functional cases.

Myocarditis—Grided ever-uses light in type and brief in duration, such as those described for valvular lessons, are indicated in this condition as well, with a careful checking up of the associated physical finding. This is one of the few cardine conditions in which the results of the plication of diathermy have been distinctly beneficial. Flexible composition plates, about five by seven inches are used anteroposterially. It is essential to have a steady current which must be applied very gradually. From five to seven immedes should be used in raising the current to maximum of 500 to 600 milliamperes which is maintained for twenty minutes mining in addition four minutes in which slowly to reduce the strength of the current. Relative rest should be insisted upon for at least two boars after the treatment. Its effect upon the coronary circulation brings and

Intermittent Claudication—Grunbaum, of Vienna reports secess in eight cases of this condition treated by a technic of direct of athermy similar to that just described extending over a period of four to eight weeks. These cases were mild in type and his results were unit

formly good

functional cardiac disorder' He was dyspucie nervous and his tachy cardia was greatly exagnerated on the slightest effort

July 16-pul c sitting 116 standing 1.0 July 29—pulse sittin. 72 standing 7.

## IMPROVEMENT STATISTICS FOR WEEK

G 4 3	A & Pl Rt	
	S ti g	St d g
July 4 Betore exercic After versice Au, u t	ارب 81	98 92
Lefore exerci e	40	J? 8(1/

During the summer be was able to take part in indoor baseball and other games

Shott Nauheim Exercises -Thi is a group of slow resistive exerci egiven with the object of strengthening the circline muscle lowering the pulse rate and improving the entire cardiovascular adjustment. The e exercuses are divided rou his into arm trunk and leg movements given resisted by the operator, the patient standing. The operator resists should der abduction and adduction flexion and extension abduction and adduction in the horizontal plane and flexion and extension of the elbow. He then resists trunk bending to the right and left and flexion and extension of the hip knee bent and knee extended Considerable effort is required in the maintainance of the creet no ition. In addition, rauch more enters into the resistive he movements than the effort involved in their simple execution because they require in many cases balancing on the other leg during the entire time of the slouls executed movement. Resistive ever erses in which classified these fall have been grouped as the most screen of the four types classified. As illustrated in numerous texts, these disadvantages are at once apparent and the writer believes that this type of excreise will be entirely superseded by the newer methods just outlined. It is easy to understand that even a single one of these leg resistive balance ing movements might be too strennous for a large proportion of the type of er is we had in the army Contrast the everity of a single one of the c movements with that of an entire group of bilateral slow, rhythmic joint flexions and extensions done as passive assistive or even active exercises with the pittent lying supine. Acirly every single leg exercise of the Shott Vaultum group would be stremous enough to fall into Grade " of our true classification

the least sign of distress on the part of the patient. The kessining of the accelerated pulse rate, in practically this entire group was remarkable after exercise and was found to be still lower an hour later. The exercises included in Grade 2, which was one of the largest groups during most of the time, were as follows. Patients supplied in mats.

- 1 Arms extended sideward Slowly supmated during inspirition pronated during expiration, repeated twelve times
- 2 Arms it sides Inhile and ibduct thighs Txhale and adduct thighs Report
- 3 Hands loo cly on chest Inhale and extend arms at sides Reverse and repeat
- 4 Inhale and draw up knees. Reverse and repeat. Slowly assume standing position.
- 5 Hunds loo elv chinched, on chest Inhali, hringing arms to side
- Reverse and report

  6 Inhale, rusing thigh with knee bent Tribale, extending he in hale lowering foot to floor about tache inches in front of the other. Exhale, bruiging foot bed, even with the other. Report
- 7 Hands on hips Inhale, bending body forward Reverse and repeat Head up all the time

Statistics compiled by I t Col Carr from Grades 2 and 3 showing the average improvement during a single week are significant

IMPROVEMENT STATISTICS FOR WEEK

G de	ive g Ple Rate	
	8 tt g	bin d g
July 28 Before exercise After exercise	8.5% 80	10°/s
August 5 Before exercise After exercise	81 ² 3 79	91 84 Ś

It is interesting to note that before exercise on July 28 the pulse rate was increased twelve beats by stunding and after exercise thirteen beats, and on August 5 the increase was but nine and one third and five and two thirds.

This decrease in pulse rate following evercise was practically constant A few organic cases with normal heart rates were included in the everages which makes the gain in the functional cises ill the more staking. One case is of especial interest. I ientenant Colonel B., Diagnosis

Gastre and Duodenal Ulcers—Temporery rehief from pain may be obtained through the application of radiant light. Some writer, believe that the body raying with ultraviolet light is an and in the healing process. There are certainly no contra indications to its use. The application of diatherms, entiusiastically recommended by some, impresses the writer as containing an element of danger of bemorrhage which it is difficult to guard against, and it should be applied if at all, with extreme caution. With improved technic it may be possible in the near future to reach iders in the lower part of the colon by the direct application of ultraviolet light.

Visceroptosis —This condition when associated with general neural thema lordosis or chrome constipation should receive treatment for the conduced conditions. The treatment of the visceroptosis consists largely of abdominal massages and the following everor co-

- 1 Hands pulms down under hips Flex both knees to chest, extend knees slowly and repe it
- 2 Ivan o both legs to vertical, knees extended lower slowly and repeat
- With arms extended overhead feet fixed under any convenient object whip arms forward and sit up and return. Pepcat

I rogression in the exercity of this last evereuse is attained by performing, the exercises must with the arms at the sides then behind the neck and last with arms overhead but lifted with the body, instead of actively assisting the mivement as was done in the first place. General progression should proceed from an initial start of three or four ripetitions of each movement to twelve or sixteen of each. The shdominal missage consists of circular deep kinading covering the entire surface of the abdome

Chronic Constipation—To obtain a austacory result in the treat ment of this usually resistant condition every mode of attack at our command must be followed. The duet habit time factor and occasionally medicinal and must all be employed with physiotherapeutic treatment in the medicinal grains is allowed by a behavior to the outlined came to decision the physiotherapeutic treatment in the gen and toughtning of the abdominal maceulature and improvement in the gen and toughtning of the abdominal maceulature and improvement in the gen and condition which usually follows its application; is a distinct asset if operation should be found neces are. There measures would be due timely contra indicated when the underlying cause, is inflammatory in nature although in this case a come of direct abdominal distherms in place of the fix timen outlined, ingular relieve the condition and make operation unnecessary. The treatment of simple chronic constipution consists in the use of a combination of exercises massage and electro therapy.

## DISEASES OF THE GASTRO INTESTINAL TRACT

Pyorrhea and Apical Abscess -The perfection of a variety of curved quartz applicators now permits of the direct application of ultraviolit light from the water-cooled lump with compression upon all parts of the gums Spongy, bleeding gums, with pyorrhea, yield very quickly, as a rule, to ultraviolet exposure. A narrow tapped, curved applicator is p phed to the dental margin, with firm compression. The until time is from forty to eighty seconds with a ten or lifteen second daily increment The site of an apical abscess, located by the X ray, may be treated an teriorly and posteriorly in the same was, and subsequent X rays have clearly demonstrated that, in many cases, the active condition has been climinated From six to twelve treatments are usually required

Gastritis - Bondier and Setzu both found that druthermy, applied to the stomach has a constant and uniform stimulating action on both the motor and secretory gastric functions. In both chronic and acute gastritis, the relief of pain is greater than that which might be secured by the application of any external form of hert. A careful diagnosis, to rule out malignancy or ulcur, is essential, since diathermy is contrained cated in both these conditions Treatment should be given by meins of fairly large flexible inctil plates, perhaps even by mino inches, applied anteroposteriorly over the Lastric arca, using 1,000 to 1,800 milhamperes

of current for twenty minutes

Cholecystitis —There have been many reports upon the favorable effect of diathermy in thinning inspissated hile During the passage of a small calculus, the relaxing and analgesic effect of duathermy is of distinct value in aiding the passage of the calculus into the intestine. It is not believed that diathermy can have any effect in causing the ab orption of calcult once they are formed Duthermy should be applied aniero-posteriorly by the direct method, over the gall bludder area. As is the case in all abdominal diathermy, fairly strong currents must be used, because of the low resistance of the tissues, if any great degree of in ternal heat is to be produced. Functional hypo activity of the liver may be greatly stimulated by the twenty minute application anteriorally of the static wave over the entire hepatic region

Appendicitis -In the initial inflammatory stage, before the formation of pus, direct diathermy has apparently aborted many cases The most careful checking up of the blood count with the pulse and temperature is essential, so that delay in the application of surgical relief will not occur should pus be formed In the preliminary stage mentioned, twenty minutes application of the 1,500 candle power radiant light, followed by direct diathermy, 1,500 to 2,000 milhamperes for the same length of

time, is advised

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is advisable. Either the non-vacuum or vacuum glass electrode may be used. Four to six hundred milhamperes of current should be given for from fifter to twenty minutes.

Hemorrhoids and Anal Pissures — The technic perfected by William I Citrà, of Philodelphia in the treatment of these conditions by dissication has been extremely successful. Descention has many points in its favor over the use of the cantery. The monopolar Oudin current is used This current is applied by means of a needle attached to an insulated hindle and connected by in insulated wire to the high frequency upparatus. Sincill hemorrhoids are triated by fulguration with a short spirk jump through the air Contact is a do on inclining sized and direct in strion in the larger terms. Local novocum meethesia is used interior muscularly. In treating, external hemorrhoids Citrà desicates a line across the hemorrhoid similar to the primary scalpel measion in the usual technic. The needle is then inscried into the clot and the vein destroyed. The hemorrhoid is then meased without hemorrhage and the clot curretted out.

Internal Hemorrhouds—Dests untilly a general anesthesia is employed but usually thorough local mosthicitation is sufficient. After the spliniter is sufficiently diluted each knowrhoud is grasped by the forecess and clamped at its less in the Intection of the mu cle fibers, the needle is inserted and the growth destroyed.

Fissures —Figures should be thoroughly descented followed by curetting the base is then descented again. The infected membrane is thus thoroughly destroyed and the entire tract steribilitied. I emfection his not occurred in Clirk's case. The identity of this method of treatment is given by Clirk's relieve a filter is light protoperative did comfort danger of stenosis avoided because of the mall amount of creative formed as the trauma of their axes is very slight. Embolisms avoided scause the dilated veins are emplicitly destroyed and no chance is given for clotting. Secondary hymorrhag does not occur because the vessels are seeded for a short distance below the bladds of the claim.

#### DISEASES OF THE RESPIRATORY SYSTEM

Coryza—Immuneral le methods of attack have been used upon this common condition. In the congetive tag, the combined use of several phissend agencies has been prefits since still in traditing this affection. We cover the cases with a folded town and expose the face to 1,00 candle-power rational light as closely as the patient will tolerate usually twolve to system inches for fifteen minutes. This is followed by the use of the Ondin high frequency current in each name by means of the nat all vacuum or non-viewing detroids. The detroids is gnith) unserted and curred

..00

Exercises —The four exercises just onlined for visceroptosis are useful. Their object is alternately to increase and decrease intriabdomial pressure, thereby stimulating peristrias. The following abdomial and trunk exert, res should also be used in connection with the forecome group of the control of the

1 Stride, stand arms horizontal, or liands on hips. Trunk to the right bend, straighten, to the left bend, straighten, and repeat

2 Trunk to the right turn, return, to the left, turn, return and

3 Trink forward lower, raise, gently buckward, bend, straighten, and repeat

Vassage —This consists of deep pressure movements following be course of the large intestine. The patient should be suppre, kness fread and abdominal will completely relaxed. The operator places one had above the other, finger tips on the right lower quidrant. A series of four or two deep circular movements with firm gentle pressure are given over the eccuim. The bruids are lifted and replaced two or three inches higher on the ascending colon. This procedure is ripe tied throughout the entire course of the large intestine. With the lands in the sum position using the entire pilmar surface, deep, slow stroking is done also along the full course of the colon. Walking, golf, volley hall and similar general exercises are indicated.

Electrotherapy—The imisculature of the abdominal wall and, to some extent, that in the walls of the intestines may be stimulated to increased action by the contractile electrical currents. The surging sinusoidal or wave galvanic currents twenty to thirth waves to the minute for twite minutes are best for this purpose. One electrode, about aix by nine inches is placed over the lower dorsal and lumbir spine, the other on the abdominal wall. A slow deep, current wave with toltage to telerance and a distinct rest period between contractions is indicated. Uncomplicated cases of many years' duration have been made practically normal by this combined treatment. Some writers employ the static wave over the liver and also on the abdominal wall. Attention should be directed to the associated conditions of often present. Imong these are near them a visceroptonic faulty posture and the general effects of sedentary lines.

Sigmoid Impaction —This condition, when due to atomic conditions of the musculature of the lower bowel may be treated along the lines just given and, in addition, internal rectal upplication of one electrody, the other being placed on the lower abdominal wall. Fither the smusoid if or wave galvanic may be employed. The lower bowel should be thoroughly eleaned out before treatments. In cases due to splurative spins treat ment by druthermy using one rectif and one indominal surface electrods, is advisable. Either the non-vicuum or vacuum glass electrode may be used Four to six hundred milliamperes of current should be given for from fifteen to twenty minutes

Hemorrhoids and Anal Fissures - The technic perfected by William I Clark of Philadelphia, in the treatment of these conditions by desicea tion has been extremely successful. Designation has many points in its favor over the use of the coutery The monopolar Oudin current is used This current is applied by means of a needle attached to an insulated hindle and connected by an insulated wire to the high frequency upparatus Small hemorrhoids are treated by fulguration with a hort spark jump through the air Contact is used on medium sized and direct in ertion in the lurger veins. Local notocain anesthesia is ned inter-muscularly. In freeting external hemorrhoids Clark desicutes a line acro's the hemorrhoid similar to the primary scalpel incision in the usual technic. The needle is then inserted into the clot and the year destroyed The hemorrhoid is then messed without hemorrhage and the clot curetted ont

Internal Hemorrhoids - Occusionally a general anesthesia is em ployed but usually thorough local anesthetization is sufficient. After the sphineter is sufficiently dilated each hemorphoid is grosped by the forceps and clumped it its base in the direction of the mu cle fibers, the needle is inserted and the growth distroyed

Fissures -Fissures should be thoroughly desicented followed by curetting the base is then desicented again. The infected membrane is thus thoroughly destreyed and the entire tract sterilized Reinfection has not occurred in Clark's cases. The advantage of this method of trust ment is given by Clark as follows. There is shaht postoperative di com fort danger of stenosis avoided because of the small amount of creatrix formed, as the traum a of the tissues is very slight Embolism is avoided locuse the dilated veins are completely de troyed and no chance is given for clotting Secondary hemorrhage does not occur because the ve sels are sealed for a short distance below the bludes of the clump

## DISEASES OF THE RESPIRATORY SYSTEM

Coryza - Innumerable methods of attrel have been used upon this common condition In the congestive stage the combined use of several physical agencies has been pretty succe sful in treating this affection We cover the eves with a folded towel and expo e the free to 1 500 c indlepower radiant light as closely as the patient will tolerate usually twelve to system unches for fifteen minutes. This is followed by the use of the Ondin high frequency current in each name by means of the mass vacuum or non vacuum electrode. The electrode is sently in cried and carried straight back as far as it will penetrate easily, before the current is turned The first rheostat and first spark gap usually give sufficient current The electrode is pressed gently against the different parts of the walls of the nasal passage The current should then be turned off, the electrode withdrawn and inserted into the other side From five to eight minutes application of the current to each nostral as usually sufficient to dry off and shrink the membranes considerably

The quartz light is then applied from the water-cooled lamp through the nasal applicator inserted as deeply as possible, for a minute and a half, after which it is slowly withdrawn, during the next half minute. In throats open enough to allow for the procedure, the pharyngeal applicator may then be applied through the mouth to the nasopbarynx, which is irradiated for two to three minutes In the chronic stage of this condition, the treatment is much less efficient but even then gives symptomatic relief If the treatment has been instituted promptly in the acute stage it is usual for the disease to yield very quickly

Tonsillitis - Three common types of tonsillar involvement in children have been described, associated usually with hypertrophy the acutely inflamed, those with subscute and chronic inflammation and the simple enlarged tonsil The first type should be removed surgically when pos sible The second type treated by combined X ray and the application of ultraviolet light, and the third by X ray or by surgical removal. In subacute inflammation the X ray is applied by the Witherbec technic on alternate weeks In applying the ultraviolet light, Pacini advises frequent short exposures of not over thirty seconds each, with the use of the special tonsillar applicator. This is a conical steel cylinder, with a quartz compression applicator fitted to its tip. He emphasizes the point that prolonged exposure tends to congulate the protein of the mucosa which interferes with surface dranue. The spraving of the tonsils what a dilute solution of perovid of hydrogen is sometimes advi able.

In surface infections of the tonsil and infected crypts, Donnelly ad vises the use of a localizing cylinder, beveled at the end to enclose the tonsil which is exposed for from three to five minutes with the water cooled lamp Where for my reason ordinary tonsillectomy might be contra indicated, as in hemophilia or in patients unable to take a general anesthetic, W J Harri on, of England, uses surgical diathermy The surface of the tonsil is painted with iodin and it is then destroyed by electrocoagulation, using 300 to 500 milliamperes of current William D McFee of Hwerhill has developed a technic for the removal of ton sils by fulguration with the monopolar high frequency current A special tonsil electrode is used, of wire imbedded in glass, terminating at the center of a hooded, bell shaped end This method requires from three to six applications, the slough coming away without hemorrhage, and it is very satisfactory when ordinary surgical enucleation is impossible

Diphtheria Carriers —Donnelly reports forty cases of diphtheria carriers to whom ultravolet hight was applied to the tonsils and naso-pharyax by the use of the eyhudrical localizer and writer cooled lamp. The first exposures were three to fix minutes and if succeeding cultures were not negative repeated doses of from four to is minutes each were given. Fifty per cent of thise cases were negative after the first exposure and never more than three exposures were required. Additional cultures should be taken everal days later.

In our series of five cases the ultraviolet light was applied from water cooled lump to the tonsils and throat by the tonsillar applicator for three minutes and to the posterior nares by the quartz nasal applicator for two minutes, jucluding the slow gradual withdrawal of the applicator during the last half minute Cultures were not taken in this group until after three exposures when four were found negative and one doubtful which also became negative after the fourth exposure Pacini follows the same technic with a shorter exposure less than a minute and adds the cursed rod applicator, turned upward beyond the soft palate into the nasopharynx This last procedure is important in completing the irradia tion of the entire surface most commonly infected. The middle ear and smuses occasionally involved cannot be reached directly. So eminently satisfactors has been this treatment that it suggests similar results in carriers of the organisms of meningitis pneumonia and influenza, both in the recuperative stage and as a preventive for those who have been definitely exposed There can be no question that ultraviolet light is per haps the least dangerous and most effective surface bactericide at our heemmen

Tuberculous Laryngitis—Blegrad reports fift, two cases treated by body exposure to the carbon are hight. The mutual exposure was fifteen minities, increasing gradually to one boin in about a week stime. On deep-scated local lesions he used the galvanocautery. The laryngial symptoms were greatly improved in practically circle case, although the associated pilimonary condition prevented complete cure to quite a large proportion of them.

A comprehensive technic neduces the local application of ultravolet light from the water-coded lamp through the laryingeal applicator for from one to two minutes with slow steady increase in exposure time coupled with cross-firing the luryinx by means of compression with the large surface applicator and body exposure following the technic already outlined

Oas Laryngitis —We have had many eases of gis laryngitis among the exservice men. A combination of surface high frequency and the internal application of quartz light, as jut t described, has brought good results in most cases.

'imple catarrhal laryngitis may be treated in the ame way, adding intensive radiant light externally for twenty minutes

Sinusitis — There is no question that the sinuses connected with the respiratory tract can be penetrated by ridiant light and, to some extent, by ultraviolet light, when properly applied. The effect is that of thuning, and, to some extent, sterrlizing, the evudate, thus accelerating drainage Local, intensive, high candle-power ridiant light for twenty to thirty minutes is applied directly over the affected area as close to the patient as is tolerable. Ultraviolet light with compression from the water-could lamp is then used for one or two minutes. The patient should be forwarded of the sunburn on the face which will follow this application. Marked relief of pain is usually the immediate result of the treatment Ultraviolet light should be applied, where possible, through the nose, in addition to the surface application.

Bronehitis—The favorable effect of the common external counter irritants is well known. The use of hot, heavy gunina sub tances smeared on the skin is still in vogue, in spite of their obvious disadvantages. The effects of these can be obtained much more efficiently by the use of high

candle power radiant light

In certain types of bronchitis, especially those associated with a tendency to asthma and simple croup, antispasmofics are indicated. Disthermy will relieve this condition by the relaving effect of the intense deep-seated hear produced. The sedative effect on the micross of the larger and smaller bronch is more quickly secured than by the need forugs. In cases where the expector ition is too profit e, disthermy should

he used sparingly if at all

Radiant light, 1,000 to 1,500 candle-power at fifteen mehes, is spplied, thirty minutes to the unterior and teu minutes each to the lateral
and posterior surfaces of the chest. This is followed by direct duthermy
with flexible metal plates large enough to cover the entire upper che t.
The patient may he on the posterior plute. The anterior electrode may
be held gently on the chest by the patient, but preferably by a light
studing or with adhesive plaster. Use 1,000 to 1,500 milliamperes of
current, taking double the usual time to reach maximum and to reduce

Bronchopneumonia —The effect of the application of radiant light is not as great in this condition as in inflammation of larger brouch, while that of disthermy is still more striking. Radiant light, however, should be used where possible, applied to the anterior chest wall for twenty to thirty minutes. Disthermy is given by the technic just described

Lobar Pneumona—The group of cases in my consilting service, in the United States Marine Ho-putal No 21, New York, is now largenough to justify certain definite conclusions as to the effect of distherar in this condition. This disease varies so greatly in its mortality is different seasonal epidemics and in the different types, that all conclusions to the effect of any given treatment must be most guarded. In the

literature, a fiw scattered cases of meumonia treated by diathermy are recorded. The lack of laboratory reports und duly physical findings render difficult any judgment upon the efficiency of the methods u ed. The primission and assistance of the Medical Officer in Charge and the cooperation of the Ward Surgeons and I aboratory Staff made this study possible. The only function of the department of physiotherapy was to grate the tratiment. A complete record of pulse temperature and re principle of the tratiment. A complete record of pulse temperature and re principle valid daily chest findings was kept of every case by the Ward Surgeons Dr. Trummer and Dr. Loland under the direction of Major Pron and Major Pridon, Cinefs of the Medical Service. The laboratory findings were made by the chief of that service. Dr. Taylor and a number of clear plates of principalry interesting, exists were secured Treatments were prior by the berd physiotherapy sides. Mr. 8 Carpill and Miss Bandall.

The apprenius need was a portable type of high frequency machine espable of delivering up to 2 .00 millisamperes of carrent. This and similir apprenius may be conveniently cerrised to the different wards of a loss pital or to private homes and need wherever there is an alternatin, current. The tochnic was as follows. The pittent was gently tuned on his side and the flexible metal plats shout five by seven incluse covered with hot shriving, soap lation were placed directly over the affected lobes anteriorly and posteriorly. The patient was then returned to his former position I ving directly upon the posturor electrode the holding being protected by a heavy folded towal. The automorphism was all posteriors against the cliest will by the indeer names. In the first cighteen or nimeters exist the miximum current of 2.000 mills imperes was used. The current was turned on very slowly from four to the miximum being insecting the down after twenty minutes at miximum. In the second group of cases at present under treatment, the time has often been increased to thirt, minutes and the miximum current reduced to 1.200 or 1.000 millisumperes with even letter results.

Dr Wm T Boland who was in miniculate charge of practically every case sums up the results of this work up to February 1.2 1923 from the standpoint of the internet as follows. The 1923 1323 group of ca e largely Type I II and III did not respond quite us well as the first group which were mostly of Type IV. With a single exception there was a shight fall in blood prays are with a fall in pail e rate of from five to tan points following the treatments. The respiration rate was not greatly be send but be uthing, was mind less belond. Free perspiration was induced. Following, the diatherms treatment each patient was able to sleep from one half to three hours in a quiet natural manner and the pains in the clest were less need following, each treatment in every case executions.

The results obtained in treating lobir pneumonia with diathermy in dicated that it might have an influence in hastening recovery, particularly in shortening the period of resolution There is some evidence to indicate that pneumonia may be aborted by the early and intensive use of diathermy This result has apparently been the case in a number of instances and vet it is extremely difficult to prove one way or the other. It seems logical, however, to employ it at the earliest possible moment after a diagnosis or provisional diagnosis is made, because of the almost absolute certainty that it is safe. The total duration of the active stage of the disease was apparently not affected in our cases, but the condition of the patient and the temperature findings were both markedly affected. The temperature started down by lysis immediately following the first applica tion of diathermy, in nearly every case. A similar temperature effect was noted even in the few which had a lethal outcome

This statement can be made without fear of successful contradiction A crisis does not occur in lobar pneumonia where diathermy is need. In fact, so striking is this point that in several of the scattered ca es reported the diagnosis was placed in doubt because there was no crisis In our cases the laboratory reports preclude any doubt as to the accuracy of the diagnosis Still more marked, however, are the effects obtained on the patients' symptoms in practically every treatment, the number of which is now several hundred. Cyanosis lessens or disappears, the expiratory grunt, when present, is markedly dimmished, or it causes entirely respiration rate usually falls and the breathing is less labored patient receives from two to four hours of distinct relief from distress

during which he usually drops off to sleep

The question arises as to what actually occurs within the congested lung This question is difficult to answer but we are certain that something definite occurs which relieves, at least temporarily, the overload upon the right side of the heart Lymphatic and capillary drainage are in doubtedly augmented and the intense heat produced, estimated at from twelve to twenty degrees Fahrenheit above that of the body, may me-

chanically melt down some of the exudate

The relief felt by the patient after the crisis is of course, out of proportion to any sudden physical change occurring within the lung itself and a somewhat similar and nnexplainable relief occurs here The body, at a great expenditure of energy, reacts to the toxins with a rise of from five to seven degrees of temperature, perhaps even greater than that within the congested lung If the organic structure of heart and kidneys and sufficient pulmonary tissue remains intact and the dose of toxin is not overwhelming crisis occurs and the patient is started on the road to recovery By means of diathermy we create, without the rapid burn ing of the body's available energy, a more intense and charply localized temperature We do not, of course and directly in the formation of anti

bedies The results which have been found clinically in the application of diatherms, therefore closely parallel what might have been expected. The most careful and continuous observation of these cases has at no time demonstrated thirt diatherms was harmful in any stage or type of the disease. Further study will undoubted he recall the fact that this measure is more useful in certain stages of the diese than in others. It may even point to the fact that it times, it is curry inducted. Up to the present, however, this has not occurred. It has not prevented other lobes from being affected while one lobe was being truted. The few occasions when this occurred came however, at a time when the diathermy traitments had been markedly reduced because of the improvement in the lobes under treatment.

It is believed that the marked symptomitic relief which follows the application of diathermy is great enough to turn the scales in many severe cases. Shorter treatments at three to four hour untervals during the entire critical stage, would be indicated in such conditions. The writer would urge a wider employment of dathermy in puemions. It has seemed to him to be a most hopeful type of treatment and should be coupled with the serum in those types of the diverse in which serum is indicated. We may confidently expect that in the near future our knowledge of the results of this type of therapy will be greatly increased. Pulmonary Tuberquious—There has recently occurred some chance.

Pulmonary Tuberculosis—There has recently occurred some change in our conception of the minner in which certain physical agents play their part in the triatment of this condition. It has been the writers privilege to be associated in a concluting capacity with Major Leonard Wool er Pacco Surgical Chicf, in the Phissotherapiuto Department of the Government Hospital for takerculous existence men at New Haven for the past three years. He is indicated to Major Bacon for the exposition of the theory upon which the therapeutic application of exercise and ultraviolet light to this disease is based. A brief statement of the e conception is necessary to an understanding of the tractment of the e.

cipions is necessive to an understanding of the treatment rightee. The thereof is ultimated in the body revets and as a risult of which reaction is enabled to build up a creatment fibrorial as a risult of which reaction is enabled to build up a creatment fibrorial will the boeth undergo slow attenuation in their virulence. Under conditions favorable to them they undergo development dis observed and gain become a memore. The allergence response of the tissues to the unision of the taberde bacillas is escutial to its proper defension against the organism. In many cases there remains for considerable periods a state of fair bilance in which partly attenuated organisms are surrounded by a fair amount of protecting exertive the general bodily health remaining below per Such prittents while showing normal temperature at rest may exhibit an overestive theroof hyperblyprodosis recurrent colds and typical effort syndrome. The c are the patients who

break down readily upon the attempt to resume normal activity protect such a patient properly, an increasing stimulation to the forms tion of adequate electrical tissue around the tubercle is essential. This stimulus may be obtained by intentionally stirring up the dormant bacilli to increase toxin production. By rest, fresh air and adequate natur tion the body is prepared for these responses, and the bicilli are at the same time attenuated in their virulence. This is probably the immuno logical action of tuberculin. A similar result in it be obtained by what might be called the auto-moculation method, using the effect of ex ereises and ultraviolet light to attain a systemic reaction. In seeking to bring about this result an overdose may bring disister Chincally, this condition is met with in the too early return of the patient to mater activity or in excessive doses of heliotherips or actinotherapy. Under the stimulation of an excessive dose of toxin the body attempts to recitable h its local defenses but the areas involved are increased in both size and number and the protecting structure is necessarily weaker Bacon suggests that the effect of exercise is due to changes in the fluids and con sequent osmotic pressure, leading to increased absorption of toxins in the vicinity of the tubercles, scattered throughout the spongy tissue of the lungs Both evereise and ultranolet light, as will be liter hown produce concomitant effects, distinctly fivorable to recuperation if graded so as to invoke the optimism response. The emphasis here made is to show how their employment in the wrong stage of the disease or in excessive imounts may be extremely harmful. Therefore, these potent agencies must all o be used with extreme care. In that stage of the dis ease where the temperature has returned practically to normal and the active symptoms have been arrested by rest, adequate diet and fresh ur carefully graded treatment by exercises and ultraviolet light is indicated

Exercises —After the patient's temperature has been prictively nor mal for some two to four weeks, the evereises in Group 1 may be given Anything more than the slightest febrile reaction demaids a further period of rest before again attempting evereise. If a few weeks emplinement of these pentle evereises produces no untoward symptoms, the excrises included in Group 2 may be sub-stituted. Unfavor-tible response to this evenies dosage place the pritent back at rest or in Group 1 according to the sevenity of the reaction. After four to twelly weeks of work with this group a patient may be advanced to Group 3, aftr which he is ready for duckings from the hospital or sanitarium and should be in condition slowly and gradually to resume his former occupation. These excresses may be entrusted to the well trained physiotherapy aide or physical director but must be mader the constant ob evation of the physician, who should withdraw at once any patient showing agus of distress.

#### Group 1

These exercises constitute a series of douby performed gentle exercises in which all strain on the chest wall and all vigorous breathing are avoided. They are slowly coordinated arm and leg exercises and very gentle trunk bradings which may be performed in recumbent sitting or standing positions. From two to four repetitions of each joint movement are afficient. Rest periods are very frequent during the ten to twenty impuries lesson.

## GEOUP 2

The patients takin, these corrises are a sembled in regular class formation. They are given the full number of scineral setting up exerce as performed at a relatively slow rhythm. Slowly performed marching tactics are sometimes included. There, to six movements of each type are sufficient. Good form in the execution of the movements as striven for but without speed or snap. Rest periods are given during the half but period.

### Grove 3

These exercises constitute a court is apply executed, full etting up drill with the movements repetited four to eight times each with vigor and speed. Walking ind light pimes and be included in this group. When the reaction to this form of exercise is favorable the pittents are reacted, to their discharge from the bropital or sanitarium and a return to their former occupation in fine min cular condition.

In our government he pit is these exercises have the further advantage of demonstrating both to the men and to the medical staff the

pitients fitness for leave or discharge

Ultravolet Light —The following technic of applying ultravolet light to pitteris whose condition was complicited with pulmonary tuberedous has been in operation more, than two veries at the Covernment Luber colous Hospital at Yew Haven and the re ults lieve proved eminently suffering from interpolated tuberculous. Vapor Baera divides the body into cept into amplicited tuberculous. Vapor Baera divides the body into cept incomplicited tuberculous. Vapor Baera divides the body into cept incomes four on the anterior and four en the posterior a peet. The first zone extends in the anterior surface from the feet to the kines, the second includes the anterior surface from the feet to the kines, the second includes the anterior surface from the feet to the kines, the second includes the anterior surface from the fourth the chi thand and write the third the allowing and the interior part of the foretime the fourth the chi tand neck. Zines V. VI. VII. and VIII. are corresponding are as on the posterior surface of the body. Tradition with the 2000 candle-power light for ten minutes precedes all treatments. This is an ential part of the region.

## Treatuent 1

With the air-cooled mercury tungsten lamp at a distance of thirty inches, Zone I is exposed for our minute

## Treatment 2

Zone I is exposed for our minute, Zones I and II for an additional minute. The treatments progress in this minuter intil all zones have been exposed, with a total time of thirt; say minutes. After strent treatments the series has been completed and the lump is lowered two inches, then the whole cuterior surface of the body is treated for two minutes. The next day the posterior surface is raved for the same length of time. This procedure is repeated until the lump has been lowered to twenty inches, offer which the zone method is again resorted to, increasing two zones at a time, instead of one, to a naximum of thirts surfainties. This very gradual mericle has chabled our working up to maximum in nearly

every cuso without producing increased febrile symptoms.

Lightwisherapy—The late Simon Baruch, in his tax on hidrotherapy, calls attention to the stimulative effect of cool and cold witer applied to the skin in pulmonary cases. The water is first applied at a temperatur, of thou 90° F and given at a slightly lower temperature in each six occling treatment as the patient becomes used to it. It may be applied as a spongo both or by means of the fan double and should never be given at a lower temperature from 70° F. A distinct gain in appetite, sleep adweight is claimed for this method of treatment. It would seem to be indicated in that stage of the condition in which active exercise his been advised and should be carefully watched for the appearance of unfavorable symptoms in exactly the same way as has been advised when exercise was given.

Massage —In the beginning of the quiescent period, at that stage in which restricted use of general mild exercise was advised general missage, consisting of mild petrissage and efficuring, may be employed with advantage to the vatuent.

In a light general treatment or where the four extremities only are included, only about one-third of the time should be employed as in the average general massage treatment

In the terminal stages of the disease, no procedure brings more confort to the patient than funtle general massage. It is possible to improve local circulation impeded by pressure and immobility and to prevent or delay the appearance of bed seres

Pleurits—The pain mendent to the acuto inflammation of the pleura can be relieved by local intensive radiant light and surface high frequency or direct diatherms. The 1,500 candle-power lamp at a distance of af teen to eighteen inches for thirty minutes will produce a marked analgesic effect.

Disthermy should be applied by large flevible metal plates, so arranged as to be only four or five inches apart on the affected side of the clear. In this position, beside the through and through heat a distinct edge effect is produced. The current will flow in greater density through the subutaneous tissue between the plates and heat may be produced to tolcrance. Use 1,000 milliamp.rrs for thirty minutes

With simple effusion the same technic is continued to promote drainage Emprema.—This complication requires surgical drainage. With drain age established and even the in thotou of the Carrel Dakin technic all lasts do not progress fivorible. It was in this typo of ease often fur that complicated with osteomielius of the resected rib stumps that physic interapy attained some of its most brillbar results in the miny post influence cases of this type which occurred in the Army. The treat ment, as given does not interfere in the sluthest degree with the proper surgical procedures including the Carrel Dakin tubes.

Major O M Sampson and Captum A B Hirth treated a very large group of empyone cases at Fox Hills General Hospital later the Hoff General Hospital of the Army These were largely due to infection by the Streptococcus hemolythems many of the sequelve of the influenza

pneumonia remaining

The object of the treatment is to mercase the local arterial blood supply and both the quality and quantity of the phagoevies. Radiant light used alone du not produce a marked effect. When combined with direct disthermy however the results were very satisfactory. The first caso treated had become steadily works after nine rib resections, and had thritten discharging similars.

Padists light, from a 1 500 caudle-power lamp for fifteen minutes was followed by direct datherms, applied righ, over the seris and discharging sinuses. At first 400 milliamperes of current were used gredually working, up to 2,000 milliamperes for one hour. General irridation with the air-cooled ultraviolet lump was used, with inerasing time starting at twenty four necks for two minutes. This case was entirely included in a comparatively short time.

Nagelschmidt Howaschick and Saberton have all attained equally good results in the application of diathermy to empyema. It is clearly in

dicated in all forms of pleuritis

Adhesions — Cumberbratch has had results in treating the e ca es with chlorin ionization. The writer employed in his army cases a combination of diatherms by the technic de cribed above and deep-breathing exercises.

The e graded deep-breathing exercises should be begun early while the patient is still a bed ease. They promote dramage and prevent the

formation of adhesions Once formed, adhesions may be stretched and broken up by their use Slow, deep respirations of the "pectoral type are given, with prolonged rist periods. They may, with advantage, be so ceited with bulateral arm addictions, where possible

#### DISEASES AND INJURIES OF THE SKIN

The use of radium A ray and ultriviolet light in the treatment of various pathological conditions of the skin is a recent and ripidly spread in, development in therapenties. The relative value of each of the e measures has not been definitely determined in every instance. The proper selection of the treatment cannot be standardized until the derma tologists have thorou_hiv tried out all of these measures in cases where their application seems to be indicated. Broadly speaking, this general statement holds true. These physical agents are somewhat similar in action, as would be expected from the fact that they are derived from adjoining wase-lengths of light vibration. In most dermatological cond: tions amenable to treatment by both X ray and ultraviolet light, the X ray is usually quicker in its action but has a greater tendency to scar the skin and, except under most careful technic, has certain elements of dinger not involved in the use of ultraviolet rivs. In general and diffused con ditions, like acne of the face, where temporary exfoliation by ultraviolet light might be disadvantageon, the X ray is to be preferred. In most sharply localized conditions, the absolute safety of ultraviolet light is a point highly in favor of its use

Alopeou —The general falling out of hair in early adult life yields, as a rule, most satisfactorily to the proper application of physiotherapy Bernstein isses the air cooled all mercury birrier at twenty four inches for ten minutes, increasing five minutes per day to a maximum of thirty minutes. He treats the parts every other day for three treatments and then twice a week. Wie uses approximately the same technic with the treatments two weeks aparts, and calls attention to the necessity of removing the scales if sebortheic eczema is present. One should reduce the time by half in insing the tungstein mercury air cooled burner. It is better to move the patient's had or the lamp slightly, during the treatment, so that the hair shadows will not prevent the light from reaching all parts of the scales.

of the scalp

We have found a combined technic to be still more efficient. Preceding the ultraviolet irradiation at the time, distance and daily increment mentioned, we use about eight minites local application of the surface non vacuum high frequency scalp electrode which is made in the form of a coarse comb. The ordinary small surface electrode, however, may be used instead of this special one. A flexible metal electrode may be ap-

phed to the wrist of the operator or pittint and a finger tip massage of the scalp which localizes the high frequency stimulation may then be given This may be substituted for the application of the high frequency electrode directly to the scalp.

It will be noted in many of these cases that the scalp is quite tight and the local circulation thereby somewhat impeded. With the palms pliced over the for-head and occupin their on both temporal and finally on both parietal, regions it may be lookined omicwhat by circular kined ong moving the whole scalp on the skull. It is quite usual for the hair to stop falling out and for the inthin, which generally accompanies this condition, to be entirely civile used at the first treatment.

Freatment should be four times a week for four to twelve weeks to ac-

complish lasting and satisfactors results

Alopean Areata —In this condition the chology will to a large extent determine the success of the treatment. Certain types are amenable to treatment by the technic, must given above

Anne—In sixte eves of ben it is neces ir to seeme in exfoliation of the skin to produce a listing result and the patient should be parteulirly warned in regard to this especially in the treatment of the face. The few days of disfiguration are rendered well worth while he the results obtained in most cases. Frituin this the face responds particularly well to a thorough treatment. Carain writers among them Clark give an initial dose at twicks enthes for ten munities producing a sidden and sharp reaction. Bernstein uses in initial time of five minutes did time that was inches at each sib equent fratiment to maximim of twenty minutes at twelve inches. He suce one freetment every other day until three have been given then two one of firther treatment to mean means and the meets are

Ohver points out the efficiency of intriviolet light in acide vulgaris which my be given by the technic mentioned above or with compression by the surface applicator from the water cooled high three to five minutes

Pitcher states that the X ray lets more quickly but with greater hability to the formation of sours and telanguetases

Angema — This condition may be trived with the water-cooled lump surface applicator with compression from tweaty to forty minutes repetited ever three weeks. I caus Ionis. Omilitions and G. Betton Massey that this condition by electrolysis. This may be done by the bipolar method with both needles in the tumor or by u ing a single needle and the indifferent electrical placed of where Jonis work at St. Bartholomical Mospital in London has been very necessful and he advises the carriest possible treatment of this condition became of its ripid growth in infinit. The object is to congulate the blood in the tumor and destroy the wills of the dilitted west of obliterating the earlier while not destroy in, the overlying skin. The pottice pole needle mut be platitumin and

the negative may be steel. They should be insulated with hard rubber or shellac so that they may pass through the healthy skin without destroying it. From twenty to forty minutes of current is used, scording to the size of the growth. Large growths require multiple needles. In growths less than two centimeters in size, a single positive needle should be used with the negative electrode placed at a distance. General an esthesia is sometimes necessary. The time necessary to destroy the walls of the vessel is from three to five minutes. Rarely more than two applications are neces are. William L. Clark, of Philadelphia, use desires too with high frequency current with good results. His technic is that attributed to him and described under Desiceation. He states that radium, however, is a method of choice in very large growths.

Burns—First degree burns from any cause may be treated by proburned reduction at about thirty inches by the radiant light. Second and third-degree burns present a number of problems. The bet surgical opinion seems to be leaning toward the conception that these injuries should always be considered as infected wounds. Scaling them in with some type of paraffin preparation occasionally gives brilliant results and

does greatly alias the pain, but it is not always a safe procedure
Any method which will arrest the pain, dry up the exposed are,
sterilize and at the same time markedli stimulate the now growth of kin
cells may be considered an ideal procedure. This ideal combination we
have at hand in the ultraviolet light. Those who have employed it pak
most highly of the results they have obtained with it. The air-cooled lamp
should be used, with the all mercury hurner, the initial distance is twenty
inches and the time three minutes, with one minute increment of daily
treatments. With the mercury tungsten hurner, the initial time is our
minute and a half, with one-half minute daily increment. Between treat
ments, dressings of sterile, dry gauze, not thick enough to be imperious

Where skin grafting is necessari, the ultraviolet light should be early employed as an aid. In fact, it is certain that the wider u e of the ultraviolet light will decrease the indications for skin grafting. In deeper burns, involving tendon sheaths and other subcutaneous structures, long continued use of ultraviolet light with the same technic as above given will greatly toughen and thicken the layer of new skin formed. Massage, particularly friction and vibration, and radiant light will loose adhesions and promote increased vaccularity. X ray and radium burns should always be treated with ultraviolet light by the same technic. I have seen, especially in X ray burns, the most astom hing results in a number of army as where skin grafting had been thought necessary and was finally not employed.

Boils—Wise states that no other remedy is as capable of rehering pain and skin tension as rapidly as ultraviolet light in furunculosis. Bernard skin tension as rapidly as ultraviolet light in furunculosis.

stem uses the un-cooled lamp ten to fifteen minutes at twelve inche carefully covering the surrounding tissue. The greater bactericidal propient of the water cooled lamp would indicate its use with firm gentle compression from the quartz surface applicator. The length of the treat ment may extend from five to twents or even thirty minutes with no ill of fect. Surrounding areas should be carefully protected with adhesive plaster or other covering.

Our own recent series covers about seventy five cases. Those cases appearing for treatment before the central softening had occurred were aborted almost without everytom by a single exposure, to quartz light. Most four fifths of the total number of cases in our series is included in this group. More advanced conditions, should be inceed and surgiculty cleaned. Our technic consists of the application, as elect as is tolerable of the 1,500 candle-power hight for ten to twenty minutes followed by the water cooled ultravoide high through a localizer or with compression if possible for five to ten minutes after which a drain is inserted according to the following the continuous surgical procedure. This technic is repeated dails after the old drain has been removed and the boat eleaned. The period of sterilization and filling in with new tissue to complete herding is invariably reduced from 50 to 75 per cent by this combined technic. It is an ideal illustration of the correlation of surgical and physiotheraponitic procedure. Carbinules—These or treated by earthy the same technic and with

the same indications as regards incision and draininge. This condition too in the early stage is frequently aborted. Poth with earbuncles and boils outreme induration is often present in the surrounding tissue. This stasis impodes the proper vascularity of the part and is usually one of the causes of the excessive pain common in these conditions duration may be greatly dimini hed by the use of the static effine Mechanical removal of the surrounding induration hould be followed by an effort to increase the active blood supply to the part. As has been repeatedly mentioned this can be done in no way so well as by diathermy We find in this condition a special use for the edge effect of heat con centration in the skin and subentaneous to sue between two closely placed electrodes Flexible metal plates are therefore selected containing from three to av square make prepared as usual and applied opposite each other a short distance from the infected tissue 1 small amount of current from 300 to 600 milhamperes is tied. The relief from pain is often almost immediate and the acceleration of the healing process is as a rule visible hastened

Galloutes —The conditions hould be softened by prolonged sorking and I vite application of the ordinary corn mixtures. This way also be accomplished by softium chlored somewhen wong 2 to 4 per cent silt solution on the negative pole applied directly to the calling groung 8 to milliamperes of current for tharty to fifty minutes. If not then re-

unovable en masse the callus should be shaved or scraped to as great a degree as possible without cuising, bledding. It may then again be made after the technic just described or treated with the large quite surface applicator from the ur or water-cooked ultraviolet lamp, using twenty to thirty minutes with firm compression. Resurrences cut, as a rule, only be prevented by a proper redistribution of pressure or weight which was the original curse of the cultus formation.

Eczema —I cema hem, a group of conditions rather than a single entity, results very widely in the different types. As has been mentioned before rather mild doses of general ultraviolet light have brought on a form of eczeni in several arthritic cases. When ultraviolet light is em ploved particularly in local eczematons conditions, it should be given in tensively Large are is may be treated by means of the air-cooled light, with unitial exposure of five minutes at thirty six inches, decreasing the distance five inclus and mere some the time five minutes duly to a min mum of twenty minutes at twelve mehes. This is the technic of Bern stem. We have found, especially in our chromic cases with thick excorneted skin, that it is letter to give a massive doso at once, trying to abtum a complete pecling of the epiderinis following the initial treatment From three to ten minutes at twelves melies with the air-cooled lump will neually accomplish the desired result. With the formation of new skin, the itching, has generally entirely disappeared. In many cases it is extremely difficult to obtain an even application of the light. Skin and umeous membrane folds must be circfully obliterated and all parts of the surface to be treated should be, as far as possible, equally distant from the hurner

Epithelioma —The squamous cell type of epithelioma may at times be destroyed by intensive doses of ultriviolet helit. It yields, however, so much more readily to the separate or combined application of Yay and radium that he use of quarte helit is hirdly justifiable. Metastate extension of the and other malignances often require intensive exposurs to the X-ray which border on a destructive skin dose. There seems to be no question that a region of ultraviolet light especially in those who tan, will protect the skin somewhat from X-ray burn. Just how far this protection extends and to what desired.

X ray doon, e, has not been worked out definitely.

In advanced spathelioners, with slow, huge and offensive discharge, the
ultraviolet light is most useful in minimizing these distressing symptoms.

There are many cases beyond surger and where intensive does of the
light will clear the field to a degree unapproached by practically any other

means at our comm nid

Erysipelas — A surprising amount of effect upon this condition his been attained by such a simple procedure as the application of radiant light. This measure should be applied to tolerance for several hours if possible. The use of ultriviolet light has been successfully employed to several writers. The technic as given by them is practically the same initial distance thirty six inches time have minutes lowering the lump a few inches duly to eighteen inches ind mere using the time for a miximum of five to fifteen immitted shall. Transmitts should be given on ultrinate divis. It is difficult to see why, with the surrounding area properly protectly, a destructive skin dose of ultriviolet ten to fifteen inches for tra to fifteen minutes, depending upon the type of lamp used, should not at once be suffer.

Erythema Induratum —Oliver reports a number of cases successfully treated by the water cooled ultravolet lump. He carefully protects the healthy surrounding skin and uses compression from one to two minutes.

directly over the affected area

Leukoderma—Poomey secured by means of the air cooled light a complete pigmentation in some of the affected areas of the skin and he as able to obtain some degrate of parametation and air as tracted. This new pigmentation persisted for mostles with no appreciable fading. For itinately, the results secured in the truttion of areas on the face were the most satisfactory of any part of the body. In areas of the body normally covered by clothing, only partial pagmentation my be ceited. Ludus—In the or themstons type Clark secured, our results in twelve.

Lupus —In the erythematous typ Clirk secured good results in twelve

thirty five minutes

Clark's group of ea (s) of lupus vulgaris were cleared up by not more than three exposures. He couply sed the same technic as in the crythematous type. It usen has secured good results with the us of the earbon are lump.

Nevi.—The flat type of next sudd quite raddly to intensive does of ultraviolet light with firm compression. It is nece sary to secure a good burn and blistering to obtain a strafactory result. As much as 30 per cut improvement often follows a single application. Clark Pernstein and Oliver complex a practiculty identical technic. The surface quartrapplicator with the water-cooled light and heavy compression is used from twenty to forty minutes reported every three weeks as long as it is accessive. I revolve treats the former type by neglecular innuitation with the gilvanic current cuiploying a milliviaper resuld in me, a technic similar to that described for the distribution of an ionia.

Psorans—The freetiment of this condition gives quite varied results and the guiral tendines is to a returned. Using the airccoled quarticles are the first sense and others start with an initial distince of thrist-security in the which is reduced graduilly to twelve and an initial time of ten minutes murical graduilly to tharts with the surrounding areas protected there can be no objection to the more prolonged initial exposure.

I della Wiss and Oliver, who complex from the start the miximum do e

of Bernstein's technic. Treatments may be given every other day with the former and once a week with the latter technic

Prurtus—This chrome condition is very common and very risitant to all types of treatment. As is well known, the pallistive outments to which most patients turn for relief tend, in the long run, to aggravis the condition. Underlying constitutional causes must be considered and where possible removed. There are many cases in which autogenous vacines and local applications of all sorts bring no relief. Radium and X-ray are often useful, but are not always free from danger. Ultraviole light has definitely and rather permanently relieved a good many of these conditions. Quartz surface applications with compression from the water-cooled lamp are to be preferred in those locations in which its possible to use them. Folks of skin and mucous membrane must be fit tened out so that the compression and irradiation will reach all portions of the affected area in equal concentration. A destructive dose of two to four minutes is indicated.

In pruritus senilis Prevost has secured results by the application of static brush and high frequency effluve in conjunction with the X ray Rolfe reports very satisfactory results in thirty uncomplicated cases of pruritus ant of from eight months to thirty five years' standing From twelve to fifteen treatments were required by his method of zinc chlorid and rodin romization which relieved at once the intensity of the symptoms An almost complete relief from the itching persists for one or two days immediately following the treatment, and the return is less inten e each time During the course of the trentments no local applications are used, hut local cleanliness is insisted upon Rolfe employs a 2 per cent zine chlorid solution The ordinary galvanic plates are used, except that the active circular electrode is provided with a flexible metal back which can bo bent and carefully shaped to the contour of the part to be treated The patient is placed in the right Sims position with the indifferent electrode under the right buttocks. In moist macerated conditions of the skin, the zinc chlorid applied by the positive pole is used for two or three treatments following which iodin is employed. He uses Lugol s solu tion diluted with four parts of distilled water at first, later less dilute solutions may be applied The iodin is applied from the negative pole as the active electrode Cotton may be souked in the solution and directly applied to the part with the active pad placed over it A rather long treatment, from thirty to forty minutes, is indicated, using only 3 or 3 milliamperes of current Treatments may be given daily it first, then twice a week. Rolfe rightly emphasizes the value of continued treatment at weekly intervals, for a short time after the disappearance of the symptoms

Tinea —This condition will often yield to intensive doses of ultra violet light — Air-cooled or water cooled irradiations may be given at three to six inches distance for three to ten minutes repeated every third day as long as is necessary

Telanguetiasis — This is best treated by the water-cooled ultraviolet light using surface application with compression. It may be given from ten to thirty minutes and repeated every ten days or two weeks, if necessary

Ulers—Ordinary variesse where will head as a rule more ripidly under the application of ultraviolet helpt than by the usual routine surged procedures. An air cooled light is to be preferred to the water cooled, except where there is much infection, when the u e of the latter is indicated. Showell emphysizes the value of prelumnary surgest cleansing and the use of status epirks and efflue to reduce the induration of surrounding tissue when present. This will greatly assist in reliving the lymphatic status and reinstituting the normal blood supply. The leg should be kept elevated during the entire treatment and after the treat ment should be handaged firmly and excity from the toes up while still elevated.

The ultraviolet light should be applied in stimulative doses, the initial one bitin, from four to five minute at thirty inches, with a richetton of distance to eighteen inches and an inert see in the time to a maximum of twinty minutes. The treatments should be given every second or third day. We or riports prompt bending in many, exics o treated and Oliver speaks of almost uniformly good results in twenty five of his cases which were healed with a good thick, now quithchium. Oliver exposes the skin for about an inch around the ulcer and u is a two minutes at ten inches once a week. In my cases I have employed radiant light for ten minutes followed by the ultraviolet hight and have u of massage as an aid in the removal of the commonly associated himphatic status.

Ulcers of the pressure variety following the removal of easts or the ordinary decibitd type are treated by stimulating massage of the sur rounding treates the removal of Isuaphite stays is static or massage and by the direct application of radiant light and ultraviolet light with a similar technic to that use even.

### DISEASES OF THE GENITO URINARY SYSTEM

Amenorrhea —Ca cs where operative procedures are not indicated may be treated by physiotherapy

This condition when as ociated with neurosthema and low blood pressure is amenable to treatment by state charge, from the negative pole. Where amena is pronounced a course of general actionsheray, whould be given. Turrell has secured good reality by the use of dualiterian. Fight to twelve hundred unillumpress should be given for thirty to forty min

utes with one electrode on the lumbur rigion and the other upplied over the ourses. The plate should be about five by eight melies. The trial ment is begun a week before the expected period and continued daily until mention because

Dysmenorrhea — I ewis Jones and Cumberbitch advise the emplorment of static charge with effluxe to the humbar spine be image a week or ten days before the period and discontinuing the treatment at its cost

Turrell has secured results with direct distherms, using a large in different electrode over the lower back and a smaller active electrod, over each ovarinn region in turn, 2,000 milliampers for ten minutes in each region. Treatment should be instituted three days before, and may be given during the period of the pain is severe.

Exercise — Mosher, Drew and the writer have repeatedly emphasized the fact that women must be taught to regard menstration as a perfectly normal function and not as unlines. The value of high teverese during the entire period in the ab ence of real nathology has been proved

Many eases are due in part to fully posture, improper clothing constitution and other conditions which must receive attention. Warm bith

ing is not only safe but advisable

Walking class room exercises, light floor work and tactics should be
given without interruption. Violent athletics should generally be inter-

dieted for two or three days

Special exercises should be given to all sever, cases. The effect of this exercise treatment in a large group of college women, reported by Clelia Mosher of I cland Stanford University, his been to shorten the total length of the period, diminish the pain and improve the mental st

titude of the patients

The patient is placed in the supine 1 in, position, knees fleved One hand without pressure or a small book is their placed on the abdomen The patients attention is directed to the rising and lowering of the abdominal wall to the grantest possible degree without straining by slow, deep respiratory movements. Thus the displaying its used as suction pump to deplete pelvic conge tion. Fine to ten expertitions of the exercise are advised morning and night every day including the men rust period.

Endometritis — Few conditions are more satisfactorily treated that this one by electrother epeutic measures. Except in the presence of placerial tags, nonzation has even whentage once curetings in the treatment of endometritis. It is more safe and less inconvenient, requiring no special preparation, hospitalization or loss of time. Every part of the endometrum is reached, every exply of the mucous membrume is penetrated.

W J Turrell emphasizes the necessity for employing a correct technic. He surrounds the patient's lower abdomen with a bath towel wet with saline and binds on the metal pad completely around the body over the towel. The metal p d is then connected to the negative pole of the galvanic michine Zinc or copper sounds may be u ed as the positive pole. The former are cho en when the septic discharge is pronounced and the latter in cases where there is much bleeding. The sound selected is insulated in its vaginal portion by rubber tubing. Turrell treats cervical erosions at the same time by wrapping a piece of absorbent cotton sorked in a 2 per cent zine sulphite solution fround the sound and applying it to the os The patient is placed in the Sims position, the sound carefully introduced and the current turned on very gradually. Twenty to thirty milliamperes of current are u d for afteen minutes. If pain occurs the current should at once by reduced. Cases which develop avere ovarian or tubil pain during the stancit should be referred to the sur gron at once for a thorough recommutation. If any difficulty is en countered in the removal of the sound Curaberbatch has suggested revers ing the current for a hort period of low intensity. This will permit easy withdrawal He and Sloan us a glas speculum.

Cervical Erosions -The technic of treating this condition by zinc contraction with the galaxing current has not been described in the treat

ment of endometritis

The perfection of the united speculum now permits the application of ultraviolet hight directly to the crived lesion. One or two minutes in direct apposition should be given from the water-coled lamp with light daily merease in the time of the expo ure

Improved circulation may be coured by the application directly to the cervix of the high frequency variant electrode. By the u e of this internal electrode and a surface plate electrode about say by eight inches in size a direct diathermic current may be given which will creatly hasten the heiling of old lesions. Eight to twill hundred milliammeres are used for twenty nanutes. The surface plate may be applied to the lower abdomen and lumbar some at alternate treatments

Infantile Uterus - I rote or B C Hir t of the University of Penn sulvanta has described a technic which has been very succe sful in the development and restoration to function of the infantile type of nitra is usually preceded by cervical dilutation and a course of corpus lateur and pituitary extract which almo often give no results. He bi ed his work on the theory that the interine min ele can be illuscloped by electrical stunnilation as can any other atrophied or poorly developed muscle His technic is as follows

A copper electrode is in crited into the interine cavity with the necessary a optic prevautions. A large pour electrode is placed over the abdomen the pitient is then given galvinism with the negative pole in the uteru 9 to 12 milliamperes. This i followed by ripid and slow faradism, familie by the sinusoidal current, the treatment continuing for twenty minutes and bein, applied every other day intermitted in eye the menstruction occurs, but otherwise continued for about three months Results are not secured by less than six weeks' treatment. No infection of the endometrium or of the appendages follows this treatment, but naturally the greatest care in aseptic technic is necessary. The use of both faradic and sinusoidal is probably unnecessary.

In case the cervical canal is too narrow to admit one of the copper tipped electrode inade for intra uterine use, a narrow, flexible platuam electrode is employed which is practically indestructible. Another result of this treatment is the perminent enlargement of the cervical casal by electrolysis so that the dysmenorther, which is an almost constant accompaniment of the lack of physical development, is usually perminently carred.

G Betton Massey employs a similar technic, giving the intra uternot treatments but once a week. He points out the contra indication for this technic in inflaminatory conditions of the tubes

It would seem here, too, that the selection of either the faradic or the sinusoidal current should suffice, if combined with the constant current

Pelvic Inflammatory Conditions—Sperling obtained 50 per cent of subjective cures and 43 per cent of relief of symptoms in a variety of these conditions in one hundred and ten cases. He used direct diatherms Continued treatment was required in some cases.

The greatest care must be exercised to exclude eases in need of surgical intervention on the other hand, much may often be accomplished

in many cases unrelieved by pulliative procedures

Great relief often follows prolonged radiant light of high cuidle-power followed by gentle, long-continued diathermy, which may be given by me ins of anterior and posterior surface plates or be alternating them and using the vacuum or non-vacuum vaginal electrode as the other pole. Thirty to forty minutes' use of a current of 600 to 1,200 milhampares is indicated.

Many cases of low grade chronic inflammatory conditions are assed ated with a persist int chronic passive congestion of the entire adnexi. These patients do not take the general exercis, which increases the respiratory excursions of the draphragm and tends mechanically to relieve this congestion. There should, therefore, be given in association with the radiant light and databetrary, gentle deep respiratory exercises of the abdominal type, two or three times daily. The patient should be in the dorsal recumbent position with knees rused and take five to fifteen deep respirations.

As soon as local tenderness and pain are robesed the patient should be encouraged to take light evereuse of a general type. Cases complicated by chronic constipation may, as soon as the cessation of local tendences permit, begin the series of abdominal evereuses outlined in the treatment of that condition

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Enuresis—A toning up of sphineteric muscle and nerve control sufficient to abate this condition has often been accomplished by electrical stimulation

Turrell employs a coarse wire faradic current, applied to tolerance, by electrodes placed on the perincum and lumbar region for ten minutes

In adults the application of the static induced current from the negative side of the static machine, he means of a reetal electrode, has given good results in a number of cases. A slow surping current is used for ten to fifteen minutes.

Gonorrhea—In the female this divease is often extremely resistant to treatment. Kyaw has found the organisms to be killed in air hours at a temperature of 40°C. In three hours at 42°C and in one hour at 44°°C. His patients withstood a temperature under diathermy of 44.5°°C for hours without harm. He used one vaginal and one surface electrode for three hours at times extending the time to nune hours with three hours intermission. The temperature may be checked by thermometers in vaging or rectum. No other writer employs such lengthy treatments or speaks as certainly of obtuning a cure

Von Buben reports a number of cures by the use of duthermy in cases which were resistant to other methods

Zine or copper ionization by the technic described for endometritis has been used with success by Cumberbatch and others

The combination of Lyaw s intensive diathermy regime, with direct irradiation by ultraviolet habit from the water-cooled lamp by means of

the quartz speculium should prove an efficient means of treatment. In the male, the late W. J. Morton used a zine or copper ionization of

the entire urethra Breiger of Berlin employs prolonged radiant light directed on the urethra Diathermy has been applied with one surface suprapulic and one metal

Diathermy has been applied with one surface suprapidic and one metal sound electrode using low currents of 100 to 300 milliamperes for thirty minutes. Great cuttion is nece sars with this technic

Complicating orchitis and epididvantis are treated by radiant light and diathermy, a cup-taped electrode bring applied to the scrotum with the indifferent electrode on the lower abdomea.

Prostatitis—Certain types of this disease can be efficiently treated by physiotherapy. Malignancy must be ruled out. Simple bage enlargement yields most satisfactorily to the application of the Morton wave current applied per rectum. In dense fibrius infiltration only the accompany

in, edema can be reheved
Massage of the prostate can in no other way be as well or conveniently
one as with the Morton wave current. This indication is so common that
it is surprising that this best of all methods has been so greatly neglected

by the profession The wave rate bould be given at two per accord This method is painless cleanly and thorough in its results. The metal rectal

the menstruation occurs, but otherwise continued for about three months. Results are not secured by less than six weeks' treatment. No infection of the endometrium or of the appendages follows this treatment, but naturally the greatest care in aseptic technic is necessary. The use of both faradic and sinusoidal is probably unnecessary.

In case the cervical canal is too narrow to admit one of the copper tipped electrode mide for intra uterine use, a narrow, flexible platinum electrode is employed which is practically indestructible. Another result of this treatment is the permanent enlargement of the erroul canal by electrolysis so that the dysmenorrhea, which is an almost constant secompaniment of the lack of physical development, is usually permanently curred.

G Betton Massey employs a similar technic, giving the intra uterner treatments but once a week. He points out the contra indication for this technic in inflammatory conditions of the tubes

It would seem here too, that the election of either the faradic or the

sinusoidal current should suffice, if combined with the constant current.

Pelvio Inflammatory Conditions—Sperling obtained 56 per cent of subjective cures and 43 per cent of relief of symptoms in a variety of these conditions in one hundred and ten cases

He used direct duathermy

Continued treatment was required in some cales

The greatest care must be exercised to exclude cases in need of surgical intervention, on the other hand, much may often be accomplished

in many cases unrelieved by palliative procedures

Great relief often follows prolonged radiant light of high candle-power followed by gentle, long-continued diathermit, which may be giren by means of anterior and posterior surface plates or by alternating them and using the vacuum or non-vacuum vagunal electrode as the other pole. Thirty to forty minutes' use of a current of 600 to 1,200 milliamperes is nudested.

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copper wire about its shall near the attrehment end the wire acting a a conductor. The other end of the wire is attrehed to the cathode binding post.

The aspirating needle attacked to its aspirator as well as to the clotter apparatus is earefully inserted into the cust and the contents of the litter withdrawn. A fully developed cyst, with little or no paren chunal tissue overlying it, usually collapses at this time. The needle, still in position within the eyst, is detached from the aspirator ind, implyed as a cathodic electrode, 10 to 15 millismperss of current bring turned on for ten immutes. This will produce a triothy liquidaction of the tissue in immediate contact with the needle mixing subsequent in errion of the tomizing probe casy after the current has been turned off and the needle removed.

At the completion of the apparation and the electrods as of the sinus the wire to the indifferent electrode is chinged to the cathode limiting post and a hort zine probe with free point made from one thirty-second inch zine plate, is friely coated with mercury by amalgamation, titakened to the anode limiting post by her wire and inserted into the actificial, the needle opening. A current of 5 to 10 milliampers is then turned on and munitained for a quarter of an hour. It is site of puncture is dressed, after the application and daily there (the with dilute zine or of outtiment and gauze. The patient may remain umbulant. In three days a second initiation with increasing on the zine probe

is applied through the opening in the tina slough. At the end of a week or ten days the skin slough will be found k is ned revealing a minute sinus leading into the evst through which addition il mercury ions should be diffused every third die from in amalamated zine probe passed into the sac. At the end of the third week the zine profe should be insulated with fu ed ealing wax before amiljamation the insulation leaving a half such at the point bare. The purps e of the insulation is the pro tection of the sinus walls from further enlargement by confining the ion diffusion to the sac itself During the course of the treatment the later insertions of the ionizin, probe are mid le s punful by placing a drop of cocum or process sciution on the orening had or six minutes prior to its insertion. All ionizations are of lifteen minutes duration with a current strength dictated by the sensitiveness of the pitient, of between 3 and 10 milliamperes. The final ionizations during the fifth to the seventh week are not much more than problems with a little current for sterilization, until the wound closes fully from the hottom. This technic may be varied by miking a free opening with a mull bistoury and immediate ionization at the first application or by the use of the mercury ion alone held in amalgumation on a solid gold probe. The use of the rine ion in association with the mercurs ion as de cribed above is thought however to be more quickly destructive of the eyet wall than

electrode may be inserted by the patient and is easily retained. The positive pole of the static machine is used with the terminal separation slowly increased as the toler unce of the patient permits.

Painful inflimmations are best treated by diathermy using a rectal metal or nonvicuum glass electrode and a surface plate on the abdomen.

Six to twelve hundred milliamperes are used for twenty minutes

Victor C Pedersen of New York, reports a number of cases of genorrhed prostutitis in different stiges in which most stitisfactory results were secured by electrother pentium measures. He uses the high vacuum gliss prostatic electrode attached to the negative pole of the statum elinie. The use of a short spark gap of one such proved soothing in authorises. Where deep massage is indicated the positive pole and wide spark gap is used.

Nephritis .—In acute nephritis the stimulation of the exerctory function of the skin is all important. The radeant light ethinet bith or boly both, with superheated dry air with the patient recumbent, is one of the most efficient methods we have of recombishin, this result

These treatments should be given at a relatively low temperature and may be continued for several hours when necessary. The value of this

procedure in ho pital prietice can hardly be over-stimated. It would seem logical that in certain cases disthermy of the kidney should prove of value. The writer used this method in three cases which were in a state of come. Two were apparently quickly and markelly improved and made a complete recovery from the attack. The other case was not improved. No estimate of its value can be made from these results other than the fact that they would can to justify further employment of this meisure. A large plate, thout six by ten inches, was placed on the abdomen and a smaller one, four by seven inches, over each kidney, in turn, using 1,200 milliamperes for twenty minutes on each

# DISEASES OF GLANDS DISEASES OF THE EAR, AND SCARS

Oystic Gotter—G Betton Mas ev of Philadelphia in es drainage and ionization to destroy the sac. A preliminary aspiration is made to confirm the diagnosis and only those cases with fluid present are treated by this method

With the patient recombent on the operating table, an indifferent pulsiplaced beneath the bick and connected temporarily with the mode of a direct current apparatus. The skin over the most prominent part of the cyst is anisthetized over an area of about a square inch by endermic injections of a 2 per cent solution of either process or appothesine, and a rather large aspirating needle is prepared to function as a chicked, as well as an aspirator, by winding the end with a sufficient length of No. 34

been done to warrant definite conclusions. It seems, however, as logical to stimulate a poorly functioning gland by means of distbermy, the effect of which measure can be so definitely localized, as to supply arthracially the body with the gland extracts. Already attention has been directed to the possible effect of X ray upon various glands of the endocrine system

Ottis Media—In the beginning of the acute stage the immediate and intensive application of radiant light is one of the most satisfactory procdures in the whole ruge of physiotherapy. If taken sufficiently early, the inflammatory condition may often be immediately stopped. In later cases indications for puncturing the drum remain as usual but radiant light should be applied and persisted in, whether or not this procedure is necessary. Any form of electric light, even the ordinary inendescent bulb will serve in an emergency for home treatment. The hundred candle-power hand lamp placed on a pillow, eighteen or twenty inches from the bead, is very efficient. Few cases so treated from the beginning will go on to suppuration or mistoid involvement. The effect upon the patient has been described by otologists who have used it extensively, as being out of all proportion, to the amount of heat developed in the surial canal.

In chrome cases A P Friel of the London Roval Hospital, states that zine iomization is a method by means of which the tympanum can be dissinfected without irritation and a large proportion of his uncomplicated cases cleared up in one or two triatments. Both ultraviolet light and dathermy have been used in chronic middle car discuss with varying degrees of success. With a cnfil electrode around each wrist and the patients little fingers inserted into the external auditory canals a mild dathermy can be passed directly through the affected region. About 300 milliamperes should be used for fifteen minutes. This should be followed by local appheation of ultraviolet light through a small simus applicator inserted part way into the canal. Success by these methods depends upon the amount of destruction that has taken place and their can be question that they are distinct adjuncts to the routine procedures.

Gatarrhal Deafness—One useful adjunct in the treatment of this condition is the application of slow, gentle, smusodal current after the technic of William D McFee of Haverhall A metal electrode is placed on the tongue and a pledget of cotton soaked in saline and wrapped around a small electrode is gently placed in the ear A gentle and efficient massage of the drum is obtained by the use of a very moderate amount of current, easily tolerated by the patient for ten to fifteen minutes

Sears—The minimizing of the amount of ciertricial tissue formation is one of the best accomplishments of modern surgery. The excision on masse of infected and meterated tissue was one of the essential lessons of the War. The physiotherapist is concerned in an modifying the remaining sear tissue as to make it as little of a handicap as possible in the motor life of the patient. The functional results secured by a regime

the mercury ion alone But, in any case, the mercury ion is essential to the method, on account of its high antiseptic action

Exophthalmic Gotter—S Solis Cohen concludes that, because of the varying and little known pathogenesis of this disease, no single method freatment will ever suffice in all cases. He divides them roughly into the highly toxic type, where the ocular, earding and nervous symptoms predominate and the gland is distinctly hyperactive, and a sluggish type, in which gland function is not hyperactive regardless of its size.

Brusted, Snow, Massey and other writers report favorably upon the effect of the galvaine and Morton wave current in virious types of goifer In our small group of cases of the active foxe type, we have used negture galvanism and static effluve with good results, but in too small a number of cases to form a definite judgment of the general value of these procedures. In the absence of hyperthyroidism, ionization from potassium rodid, using the negative pole, has produced good results. Cohen uses the static sparks and static resonator effluve directly on the gland in this type of goiter. These indicated conservative methods, together with others not within the scope of this writing, should logically be tried before radical surgery, except in those rapidly developing cases of toxic type in which it may still be safe to operate.

Adentits—In both simple and tuberculous adentits of the cerrical glands, attention must be directed to the possible removal of tonsils and denoids, by genie and other indicated procedures. In the treatment of tuberculous adentits, Miller reports the results from a regime of believe to the process of the combined French Samitarium reports, as 74 per cent cured. Hyde and Lo Grasso report 78 per cent of cures in some two hundred cases treated by the same method. The carbon are and ultraviolet light have been used with similar results. There seems to be a preponderance of opinion that conservative measures should be the oughly tried out before resorting to operation. Glands in the superficial chains should be treated by compression with the surface applicator from the water cooled lamp. General irradiation with the in-recoled lamp is advisable. Results by this method have been very satisfactory where the main foct of infection were removed. Persistent sinuses may be besied up by the combined surface and internal administration of water-cooled ultraviolet light through the sinuse amplicators.

In several cases of inguinal adentits in various stages, the local conpression application from the water cooled light yielded excellent results Glands that had begun softening before light was applied were found, upon later incision, filled with serum instead of pus

The Ductless Glands—The subject of the endocrine system and the various disorders of function to which it is subject, forms too large a topic to be discussed in detail here, and too little work of scientific value in the application of physiotherapeutic measures to these glands has yet

been done to warrant definite conclusions. It seems, however, as logical to stimulate a poorly functioning gland by means of diathermy the effect of which measure can be so definitely localized, as to supply artificially the body with the gland extracts. Already attention has been directed to the possible effect of X ray upon various glands of the endocrine system

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Scara—The minimizing of the amount of cicatricial tissue formation is one of the best accomplishments of modern surgery. The excision on masse of infected and macerated tissue was one of the essential lessons of the War. The physiotherapist is concerned in so modifying the remaining scar tissue as to make it as hittle of a hundricap as possible in the motor life of the patient. The functional results secured by a regime

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of physiotherupy often determine whether or not a second excision of the cientrix is necessary

The aims of the employment of physical measures on scar tissue are

- To promote mere sed a senlarization
- To decrease the density of the fibrous tissue
- To free surrounding structures, nerves, tendons, muscles and hga ments from electricial idhesions
- 4 To increase the thickness and strength of the newly formed en dermis. All physiother spentie technic applied to sear to sue must be very carefully graded for optimum effect. Only a few of the measures and none of the dosages indicated for normal tissue may safely be employed

By the use of properly graded doses of galvanism from the negative pole we may accomplish two or three of our indications. It will be remembered that the action of this pole is to soften and liquely sear tissue and to promote vascularity. The first effect would naturally also aid in freeing other structures imbedded in the sear. The chlorin ion is an additional aid in accomplishing this result, and a slightly stronger salt solution may be used on the negative pole than is neces ary on the post tive to secure cast conduction of the current. The active electrode couring the sear must be prepared with unusual care. See that it is thoroughly and evenly moistcard and its surface smoothly applied to all parts of the sear The current of 5 to 15 milli imperes should be employed for from thirty to forty minutes and the electrodes will probably need remoistening during the treatment

Radiant light from either the high or low-candle power lamp, placed at half again the distance usually used, will promote the vascularity of the newly formed integument. The ultraviolet light from the air-cooled lump, in mild and often repeated doses, will stimulate skin cell growth This should be given with the all mercury burner, at about thirty inches for one minute with fifteen seconds' duly increment. With the mercury tungsten burner it should be applied it a distance of forty inches with ten seconds duly increase Diathermy is an aid to both the softening and vascularization of the cicatrix and should be applied by the cuff or zone method above and below the involved area The impoverished circu lation in dense scar tissue means poor and sluggish diffusion of heat, therefore a low current strength of 300 to 500 hundred milliamperes and sufficient area of the electrodes should be selected so that the current density will not be over 50 millismperes per square inch

For the purpose of loosening the star from surrounding structures no apparatus quite approaches in effect the use of the heavy long stroke motor vibrator The vibratious are oven around the seir, workin, cen trally as far as tenderness will permit Static sparks, Morton wave, massage and even at times the sinusoidal current may be employed for similar effect. The use of intensive local heat from superheated dry air or the paraffin both is apt to produce large histers and destroy the newly formed skin.

#### POSTURAL DEFECTS

The effect of faults posture in lowering the working efficiency of the individual is pretty well established. Marked increase in total fatigue casues when the mechanics of weight bearing are faulty. The functions of the respiratory system and gastro intestinal tract are interfered with to a large degree by the habitual assumption of bad posture. Visceroptosis often due primarily to this cause. It is the opinion of the writer that many of the so-called organic or structural orthopedic types of spining defect, typified by scolicous are nearly always postural or flexible in type at first but become fixed by the effect of long-continued habitual malpositions of the soft it uses. Only in associated calcium deficiency or cases of severe degree and long standing do lony changes occur. This point emphasizes the value of early treatment.

The correction of faults posture especially in school children lies distinctly in the field of preventive medicine as well as in that of thera peutics. Physicians, parents and educators are not yet fully awake to the

vital importance of this subject

The general indications are the same in nearly all of the types of postural defects, they are

1 To recducate the muscle sense to the correct attitude 2 To improve the muscle tone and vigor of the entire body

3 To stretch those muscle groups which have been allowed to shorten by the defective carriage

4 To strengthen and thereby shorten the physiological opponents

of the contracted group

5 To increase the general flexibility and maintain the full range of movement in the joints

To accomplish these results we employ orthopedic and general evercities massage and electrotherapy. Other physical measures considered in their respective sections are used when rickets or infantile parallysis are associated conditions. Much space is given to the severe types of deformity in the orthopedic texts but very little information on the causes diagnosis and treatment of the very common postural defects appears in the literature. For this reason a linef general discussion of each type of defect is given with the treatment regime.

Head and Shoulders -The combination of round shoulders and for ward position of the head is the most common postural slump. Defects of hearing and vision and improper sitting in school are the greatest causes of the poor posture In slight degrees of round shoulders, the lower angle of the scapule, only, may be prominent. In the more severe types the entire inner border assumes the "winged scapula" position The correction of the head position is secured by the exercises of head retraction The child thrusts the head forward chin up, and retracts the head slowly and forceably bringing the clini down. This may be made a resistive evereise hy the child supporting himself by the hands, arm's length from a wall, the operator standing behind him and resisting the head retraction, hand or hands placed behind the child's head A great deal has been written about the fundamentally correct posture Many of the directions given are too intricate for a child to follow The single command to raise the sternum to the utmost height will automatically bring the child into the correct posture The cooperation of parent and teacher to insist continuously upon the correct attitude is essential in the formation of correct postural habits of the round shoulders as obtained by the use of the group of shoulder exercises considered in the next topic Shoulder braces remove all exer cise from the already weakened upper back muscles and often obtain their fixations on the movable lumbar spine inducing lordosis They should be avoided, if possible

Kyphosis—This position of increased flexion of the dorsal spine is nearly always accompanied by round shoulders. It may be considered simply as a greater degree of the former in which the spine plays a part. The etiology is the same, but there is usually some definite weakness of body structure as well. Such lack of tone as accompanies undernotration too rapid growth or intercurrent illness, etc., is associated with some repeated strain on the body's structure.

## Round Shoulder and Apphosis Exercises

- 1 To reeducate musele sense
  - a Place child before mirror Assist him in assuming the correct
  - b While he attempts to return good posture, march him around the room and return to mirror, making necessary corrections in attitude
  - c With his back to the mirror, the child is instructed to assume the correct attitude is faced toward the mirror and attempts his own correction
  - To improve general muscle tone

    a General light class exercises
  - b Athletics and games in moderation without exhaustion

- 3 To stretch the contracted pectoral muscles
  - a Child serted on stool, hands to neek operator places foot on stool behind patient, knees against dorsal spine and makes retraction on elbows
  - b Child stands in frant of stall bar uprights, grasping behind shoulders Keeping head shoulders and hips in contact he performs a deep knee bending and straightening
  - c Child lies supine on plinth or narrow bench Hands behind neck, operator from above presses down on elbows
  - d Child suspended by hands from bar or ladder, operator places hands between scapulæ and presses firmly forward
  - e Child in front of horizontal or parallel bar, or behind slanting lidder grasps shoulder high arms length in front. Without moving feet he falls forward to full arm hang.
  - f Pupil with spread grasp raises wand above head, lowers behind
  - shoulders

    To strengthen the stretched and weakened upper shoulder
    - group

      a. Arms forward raise sideward carry and slowly sideward lower
    - keeping shoulders well back

      b Arms forward raise torward bend (hands to chest, elbows
      raised and well back). Sideward lower with shoulder
    - retraction

      6 Arms forward raise obliquely side-upward carry sideward
    - lower, slowly maintaining shoulder retraction
      d Arms forward bend is before trunk lower forward hands
      thrust forward and carried sideward in imitation of breast
      stroke swimming.
      - e Rotate arms completely outward forcing shoulders back.
- o To merease general flexibility
  - a Hands suspension spine twisting right and left his turning pelvis
  - b Stride stand arms sideward raise trunk to the right bend raise, to the left bend raise
- c In same position trunk to the right turn, return to the left turn, return

Lordons—Abnormal forward curve in the lumber spine is often assocated with and compensatory to kephosis. High hocks and excesses abdominal weight are also causes of this condition. The increased lumbar curve and pelve inclination adds to the strain on the anterior abdominal wall which may become relived and weakened. This is one of the contributing factors to visceropto is and chronic constipation and adds greatly to fatigue in standing. Exercises for Lordosis

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- To stretch the shortened lumbar erector spinge
- Long sitting, legs extended in front. 2 To strengthen the abdominal mu cles
  - - Supine Iving, hands at sides palms down, double knee bending and straightening
    - Double leg raising and lowering slowly
    - Sitting up and lving back,
    - d Flex knees to chest, extend feet over head raise pelvis from the table and return.
    - e Flex and extend knees alternately and rapidly n unitation of bieveling
    - Hands suspension, double knee raising

Scoliosis - Nearly 20 per cent of children show some degree of scolosis. In the examination of from one to two thousand preparatory school girl I found about 22 per cent had lateral curvature Like every other condition it is difficult to diagnose but cass to cure in its incipience Those curvatures which traighten out on hand su pen ion have been termed functional flexibility or po tural,' curves, the others " tructural or organic Po tural cases outnumber the structural type hy about ten to one, but are often overlooked in he to physical examinations.

In addition to the cau es mentioned under anteroposterior deformities most of which apply here as well, we have unilateral weight bearing and infantile paraly is iffecting the back as common causes. Mo t curres start as single C haped curves and, if untreated, often develop into double or S -haped deformities due to compensatory straightening of the pelvis or head

Many patients carry light scolioses through life with no ill effect but they are sources of very great potential danger I have een light curves become great in degree and fixed in character very quickly follow ing wasting illness infections of the rheumatic group and other conditions which suddenly lower the body s resistance Many schools and collegee are now thoroughly examining for postural defects and following out carefully prescribed individual exercies. When this procedure is manversal a great deal of deformity now present will be prevented Such examinations should be started in the grimmar school

Diagnosis.—In the examination of the back we rely upon the following five signs

- The scapula tends to be higher, more prominent and further from the dor al convexity
  - The arm waist angle is less on the side of the curve
  - The shoulder on the convex side is usually higher and the hip on

the lumbar convexity less prominent when compared with the opposite side

4 The marked spinous processes show a deviation from the plumb line in all pronounced curves. In slight ones absence of this sign does not rule out a curve.

5 Prominence on one side in the mid-dorsal or himber region brought out he trink forward bending as a sure ago of vertebral rotation and is the most reliable evidence of scolosis. A prominence indicates a curve to that side in the region in which it occurs

The subject of vertebral rotation has caused more disagreement than any other phase of this condition. It can positively be stated that there is no literal displacement without some degree of rotation and it is proportionate to the amount of lateral deviation.

All orthopedists agree that in an advanced fixed curve the bodies rotate toward the convexity thus turning the spinous proces as back toward the normal position and masking to some extent the unount of the curve and, at the same time, causing the ribs to become prominent on the affected side.

There is no such agreement in regard to the rotation occurring in a flexible curve Lovett of Boston has contributed more than any other single individual to our knowledge of the subject. His experiments on a model performing trunk bendings sitting on inclined seat, etc. seem to show that in a normal lateral trunk bending the bodies do rotate toward the concavity of the curve produced This hypothesis he applies to flexible lateral curvature as being the sime thing. In his teaching the writer has stated the cause of rotation to be primarily the result of the fact that when a column of blocklike bodies is displaced in part so that the center of gravity does not fall through the center of all the bodies, those so displaced rotate away from the line of weight bearing So in a left total curve the thick front of the vertebral bedies rotates to the left away from the center of gravity which now falls to the right of their center. No such force is at work in a normal trunk bending moreover flexible curves are slight and hard to detect because the amount of lateral displacement is nearly equaled by the rotation so that the spinous processes fall very nearly in the midline If reverse rotation took place in the clases the spinous processes would swin, widely out and their line the apparent curve would be greater than the displacement of the centers of the bodies of the vertehme (the real curve) and the deagnosis easy. Furthermore as a curve is becoming fixed and the re-rotation claimed by those who hold this theory taking place the apparent curve would necessarily become le s when as a matter of fact we know that in untreated cases the ten dency is for the curve to increase. It is believed that a flexible curve becomes rigid first by the selerotic changes induced in the muscles allowed

to maintain contraction on the concase side, then by changes in the liga ments and intervertebral dises, and lastly, and only if bony softening is present, the bone becomes distorted At what point in this gradual "set ting" process does re rotation begin? Given two left total curves of the same amplitude in two patients of equal age, one of which straightens out under suspension, the other not, does it seem logical that a diametrically opposite rotation should occur in them?

I have gone rather deeply into the subject of rotation because proper treatment is dependent on a knowledge of it. The bodies would rotate still more were it not for the fact that the articular facets are ut in different planes The flexion of the spine forward unlocks the articula tions and allows increased rotation to take place, thus bringing out the prominence on the back

The treatment of scoliosis is not extremely difficult nor does it require cumbersome and complicated mechanotherapeutic apparatus which is being less and less used in physiotherapy

Exercise is taking first place and gaining favor as our main dependence and should always be used between casts if they be deemed necessary

Exercises to reiducate the muscle sense

Use mirror as in Lyphosis Place imphasis on erect head, even shoulders and hins

Return to mirror at the end of the exercise program, having child attempt good posture with eyes closed and make self

correction Teach the position of "self-correction" in each individual case This position consists of stretching vigorously obliquely side upward the arm on the dorsal concavity and the opposite hand

is worked as far back as possible and pressed on the lumbar concavity, in total curves In double curves the child's hands are pressed against the body in the posterior axillary line, the upper against the dorsal and the lower against the lumber convexity These children also should do general setting up work and bilateral

muscle strengthening

Stretch the muscles on the concave side

The child assumes his self-correction attitude and with hips fixed against some convenient object, such as a table, bench or chair, performs lateral trunk bending toward the humber

concavity b With grasp on stall bars or horizontal bar, chest high the body is lowered to full arm's length, both legs toward the

lumbar convex side Spring sitting at side of stool, trunk inclined forward, the arm on the side of the dorsal concavity is stretched vigorously for ward and the leg on the side of the lumbar concavity is stretched backward to the fullest extent

- d The child assumes the self-correction attitude and walks sev eral steps on tiptoe, stretching the spine to the utmost
- e Hook lying supine on table, knees over the edge, both hands overhead Operator stands behind pupil grasping both hands, stretches spine fully
- f The child hangs suspended from bar, operator from behind exerts counterpressure on dorsal and lumbar convexities push ing child forward
- g Strap table Shoulders and pelvis strapped toward the con verity in those regions two central straps exert traction from below and toward the concavity
- $4\,$  To increase flexibility exercise for spinal flexibility as given under Lyphons

Other Physiotherapeutic Measures — In all cases of long standing the muscles on the concave side tend to become first spastic and later undergo chromo filmous myositis. These changes cut bo to a large extent prevented by the use of radiant h_eht and heat h_eh frequency. Morton wave and static sparks and massay, with the same technic slready given for these modalities. In severe cases requiring, easts the value of these measures coupled with exercise annot be overestimated. The circulation within the muscles and their general tone becomes greatly impaired under the cast, and a period of intensive physiotherapy should be given before put ting on another cast.

All of these exercises need not be given in a single program but at least one from each different group must be chosen to meet all indications. The stretch walk and spring sitting exercises should be taken with the utmost intensity for only brief intervals of time

# FOOT DISABILITIES

This group of conditions most of which consist in the last analysms of toxic atrophic, or transmate myosits or arthritis, are especially amenable to treatment by physiotherapy which may lead to complete restoration of function. The accepted orthopidhe measures of providing arch supports, on the other hand, more often attain symptomatic relief rather than cure. A brief review of the chology and modern methods of treating these common and disabling conditions is well worth while

The foot is designed to support the body and to enable it to move over various kinds of surface Those who still use their feet in natural fashion have strong and well-developed muscles and ligaments, broad forefeet, and grap with facility unexen urfaces upon which they walk. The fethat in standing and walking they point the feet traight forward or sheldts inward is of importance.

A study of the changes in the use of the feet induced by meden civilization, and the condition under which they mut do their work will reveal some of the reasons for the great prevalence of foot disability

In the fir t place, we teach our children to evert the feet. In the po-ture the weight is transmitted to the in ide of the foot over the arm in tead of through the forefoot. Arminge Whitman believes this attitude to be the underlying cause of weak feet. It is obviously one of the important factors in brunging about this condition. In walking with feet extred, the outer side of the heel first strikes the floor, then the weight is transmitted diagonally forward and inward to the arch causing a sever cross train. If high heels are worn when the feet are everted, the transpectors or greatly increased

We mease the feet in shoes not one of which is the shape of the human foot Certain requirements must be met to reduce to a minimum the deforming influence of the hoe. It must have a sole sufficiently thek to protect the foot from the stone parements on which we are condemned to wall, and to prevent the sides of the sole from curling up, making a hollow into which the anterior architects to fall. The toc up hould be full enough to allow free movement of the toes. Such point as the beginnesses which crowds the big toe into the halfur values point in the middle of the foot, which crowds the big toe into the halfur values point into The hoe must at all times be long enough to prevent the toes being cramped. Hummer toes often develop in children whose feet grow in length before the hoes ir even rout.

The heel is a vital factor in proper shoeing. Especially is it necessify to have a heel with a reasonable amount of cross surface. Otherwise with any height it becomes a still, or which the patient is doing a fault coordinated and very fatiguing balance exercise, using groups of muscle in which the circulation is poor and therefore recovers from fatigue slow. With the high heel also there is a trudenes for the forefort to become crowded forward and bear undue weight, as the interpretation of the steep slope of the shank cumot support its share of the weight. Ladr and perhaps mot important, is the tendency of the high heel to them the calf muscle group into a state of partial contraction, which po its long held becomes a factor in the structural shortcamp of the emuscles producing muscle-bound feet. Lovett calls attention to the fact that the arch of the sole of the shoe is often too low to support that of the fool is the sole of the shoe is often too low to support that of the fool.

In addition to the everal eprevating and deforming influence of the shoe, we have added the hard wood floor and cement patement for full measure The wonder is not that there is so much foot trouble, but that it is not nurversal

Poor mechanics of walking adopted to avoid pain from corns callosaties sprains, etc. must be recorded among the causes of foot strain

I have had many cases which verify the point so well brought out by Henry W. Franenthal of New York, that the towns of recent disease or specific infection as well as those from fone of infection in teeth, tonsils etc. play a leading role in punful foot disabilities. The influence of these toxins in retarding recovery, when there is some other more obvious cause present as well, is constantly overlooked.

We have then the foot predisposed to strain by the impossibility of normal development used improperly and attacked by the towns of this case, causing the pitient to sil relief. It is quite the usual thing for him to pass through the hands of several shoe store—foot experts, and a few chitopodists before reaching, the physician—If the trouble is entrief local the foot spilisme provided for the patient will often give marked relief. It is because such plates etc. are not curative as a rule in the long run, and because of the very frequent presence of other than local cause that a real cure is seldom attsined.

In considering diagnosis a further point made by Frauenthal is of value. He states that when pin in the free comes on suddenly we must suspect injury or infection whereas if the onset of symptoms is gradual there is strain of muscles or ligiments. E. A. Rich of Tacoma, Washing ton records the arch impression and compares it to the amount of ankle valgus pointing ont how often painful feet occur with marked valgus of the ankle and with cavus rather than with plauss deformity. Lovet found no change in the arch impressions of a large number of the eight hundred nurses be pedographed after the one of of pain in the feet. It refutes the accepted theory that there is necessarily an elongation and broadening of the sole of the foot in these conditions. I have never felt that the taking of an arch impression was essential to diagnosis.

In the examination of the forefoot sharply localized pain under the second third or fourth metitar sphalangeal joint is indicative of successor arch trouble, but may point to an inflamed of broken seasmoid or to osteo atthritis from sur cause. Occasionally we are dealing here with pain referred from the main arch.

When the pain is leated in the longitudinal sreb under the scaphoid the presumption is that this arch is under strain. It is important to remember that strain is often present in the inturally high arch before there is any sign of fluttening and is due to tunsion at the periosteal statedments of the hymmetry or in the plantar mu cles

Fxamination is never complete without testing the dorsal flexion of the foot. Have the patient sit with knees fully extended. Grasp the forefoot firmly, invert then flex being sure the patient's muscles are have strong and well developed muscles and ligaments, broad forefeet, and grasp with facility uneven surfaces upon which they walk. The fact that in standing and walking they point the feet straight forward or slightly inward is of importance.

A study of the changes in the use of the feet induced by modern civilization, and the conditions under which they must do their work, will reveal some of the reasons for the great prevalence of foot disability

In the first place, we teach our children to evert the feet. In this posture the weight is transmitted to the tuside of the foot over the arily instead of through the forefoot. Armingo Whitman believes the arily to be the underlying cause of weak feet. It is obviously one of the important fretors in bringing about this condition. In walking with fut excreted, the outer side of the hield first strikes the floor, then the weight is transmitted diagonally forward and inward to the arch, criming a secret cross strain. If high heels are worn when the feet are everted, the strain becomes very greatly increased.

We measo the feet in shoes not one of which is the shape of the human foot. Certain requirements must be met to reduce to a minimum the deforming influence of the shoe. It must have a sole sufficiently their to protect the foot from the stone parenents on which we are condensed to walls, and to prevent the sides of the sole from enring up, mixing a hollow into which the anterior each tends to fall. Into too epishoid be full enough to allow free movement of the toes. Such point as the shoe possesses should be in front of the great too and not in the middle of the foot, which crowds the big too unto the hallow valgus position. It shoe must at all times be long enough to prevent the toes being erimped Himmer toes often develop in children whose feet grow in length before the shoes are worn out.

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In addition to the exercise preventing and deforming influence of the shoe, we have added the hard wood floor and centent prevenent for full The treatment of muscle-bound feet is primarily aimed at stretching out the calf muscle group. It is the muscle and not the Achilles' tendon that is short except in cases of severe contracture. These muscles often feel hard and fibrons and are quite tender.

We heat intensely with the I 300 cuadle power lamp, use disthermy through the calf by lateral plates 1 000 milliamperes for fifteen minutes each and finish by prolonged deep slow effectings. Here the exercise which consists of standing feet parallel arms length from the wall, and lowering the body forward keeping heels on the floor, is begun as soon as the deep tenderniess in the mixtle his lessened. It is pushed as much as possible without setting up inflammatory reaction.

When as often is the case we are dealing with a combination of foot struin and muscle-bound foot, we treat by a combination of the methods outlined omitting Evereise 5. These are undoubtedly the cases that Lorett states are made better by raising the heel and he points out how many times they are made worse his suddenly shifting to a so called orthopedio shoe. These patients feel better with a higher heel because more slack is given the cell firmt-le, but the strain of valking and standing is increased and the new slack given may soon be taken up with a repetition of the symptoms.

What constitutes a cure? In the case of the arch it is the removal or modification of the cause the allaving of the inflammation and the rebuilding of the tone of the miscles and ligiments to carry without any artificial supports whatever the wight they were designed to cirry. In muscle-bound feet a cure consists in the removal of the local or constitutional cause of tenderness or inflammation with the gridual stretching of the calf muscle group until a dorsal fiving of 90° or less allows the use of a modificately low help without these onfort

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relaxed Estimate the angle between the rear of the leg and the outer part of sole. This angle should be less than n right angle—7.0° to 8.9° When the flexion is limited to 90° or more you are dealing with a misele-bound foot. This condition is present in about 30 per cent of women and 10 per cent of men seeking relief from painful feet. In women I believe it to be the greatest single factor in the causation of foot strain and to be in itself the underlying reason for a large part of the eversion of the feet described by Lovett. This is the sequence of events. In the normal step with feet straight, there is a time just before the rear hel is raised when the dorsal flexion of the foot is less than a right angle. It is at this point that a short calf muscle is subjected to undue ten on which may or may not be recognized by the patient. A slight eversion of the feet will relax this tension. If the condition is progressive, increased eversion becomes necessary with the intense strain on the arch outlined above. Sooner or later symptoms of foot strain appear.

Treatment —Our attention should be directed first to the remeral of the cause — The acute toxic or infectious conditions are generally obvious, but it is necessary that chronic conditions and four of infection be constantly kept in mind as factors which delay recovery — The proper mechanical use of the feet and relative rest must be insisted upon where possible

Anterior metatarsalgua is treated by intensive radiant light and heat or paraffin bath, high frequency, static sparks and insessage. A felt pad may be strapped on or held by an anterior arch collar when neces are

In the treatment of the main arch, the Thomas heel, extended one half to three-quarters of an inch and raised one-eighth to one-quarter inch on the inner side, is useful in nearly every case. Very rarely soft felt pads under the arch, or in cavus foot under the instep, may be ue Strapping with adhesive may be done as a temporary measure. It has not been found necessary to prescribe any areh plate whatever in the lst three years. Occasionally a well fitting arch already purchased was per

mitted while the local treatment was being given. Where the main arch is under strain we treat by radiant light and heat, 1,500 candle-power for fifteen minutes, high frequency, or distherm—given by means of one metal plate to the sole and the other enercling the ankle—and massage Exercise often makes these crises worse, when instituted before other means have allayed the inflammation in the tissies. For this reason everu e is delayed intil the tenderness has largely disponented. A very simile set of exercises are used.

- 1 Stand, feet parallel-roll ont
- 2 Walk forward on outer edge, toeing in
- 3 Toe in and rise on toes
- 4 Ground gripper walk

The treatment of muscle-bound feet is primarily aimed at stretching out the calf muscle group. It is the muscle and not the Achilles tendon that is short, except in cases of severe contracture. These muscles often feel hard and fibrous and are quite tender.

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#### CHAPTER XIII

## RADIUM THERAPI

THOMAS ORDWAY L WHITTINGTON GOPHAN AND CLINTON B HAWY

Radium.—Since the discovery of ridium in 1898 this source of energy has been utilized for the treatment of a great variety of both external and internal discoses. The earliest and perhaps the most useful, field of application was in dermatolog; and as this form of therapy proved of value in treating some of the most intractable skin discoses, such as lupus and carcinoma of the skin the result was that overenthusiastic claims were made for radium therap even in many incurable diseases,

The literature on radium therapy has now reached enormous proper tions Not only are there a great number of articles but many volumes and even journals are devoted solely to radium therapy. To this litera ture the reader is referred for any detailed account of the subject this chapter a mere outline of the technic used the variety of conditions which have been treated and the general results obtained can be described The therapeutic application of radium was developed by the French. notably by Dominici Wickham and Degrais The German began the use of mesothorium and elaborated other forms of radium therapy Radio-active substances and their products have such remarkable physical properties that the discovery and investigation of them has ridically altered even fundamental conceptions regarding matter. With this in mind and with the realization that radio active substances and their prod ucts are so varied and may be used for therapeutic purposes in the solid. gaseous or liquid form, it is not surprising that they have within recent years been the subject of extensive scientific experiment and also of widespread clinical application, even to the degree of exploitation

about ° 000 years Therefore at the present time the use of radium has for the most part replaced that of thorium

Degrals has suggested the adv stage of calling radium through Curie therapy as we now speak of Roentgen the apy wh a the Vraya are u ed in treatment. We otherwise a cered by Habn in 190. The initial cot of mesotherium is less than that of radium had it less its artisty in r ry much shorter time the half if period of me others in be g about seen persix while that of radium is

Soon after the discovery of radium by the Curies it was found that ridio activo substances produced effects similar in many ways to the Rocat gen ray In 1901 Becquerel was burned by carrying radio active material in his pocket. In 1906 the Laboratoire Biologique du Radium was established in Paris and here Dominici, Danne, Wickham, Degrais and their coworkers developed the therapeutic application of radium. In 1909 the Radium Institute at London was established for the treatment of disease by radinin

In Austria the government established a central station for the dis tribution of various forms of radio-active material to the different clinics. There is also in Vienna a Radium Institute supported by private funds, for the strictly scientific study of radio active substances. In the United States the names of Abbe, Morton, and Kelly were carly associated with the development of radium theraps. In several of the larger cities, notably Boston, New York, Buffilo, Biltimore and Chicago, there are spicial institutes or hospitals devoted almost exclusively to research and the therapeutic application of radium. Here the amount of radium available varies from 1 to 3 or more grams. In only very exceptional instances, however, are such large amounts used at one time in any particular case. In the great majority of pathological conditions 100 milligrams are suffieient, if properly employed, to produce such results as may be reasonably recomplished

Radium is an element in the strontium barium group. Its properties are now quite generally known. It is a metallic element designated by the symbol Ra Three of the commonest salts are the bromid, chlorid, and sulphate of radium. It is derived from uranium. Other members of the radio active group are thornum and actinium Radium is con stantly undergoing transformations into other substances, that is, radium becomes successively emanation, radium A, B, C, D, F, T (or polonium) which is probably converted into lead. The rate of this transformation cannot be altered by any known process or condition. During these transformations, energy is radiated from the substinces in the form of the so called alpha, beta, and gramma rays, upon the various effects of

which the therapentic action depends

Alpha rays are positively charged atoms of helium They travel at the rate of 20,000 miles a second Their ponetration is slight, indeed, they are stopped by even a thin sheet of writing paper They may produce marked chemical change but cannot be used practically in treatment except in superficial lesions of the skin

Beta rays are negatively charged electrical ions, electrons, like cathod rays, but of about the velocity of light (186,000 miles a second) They penetrate about 8 millimeters of tissue, but do not penetrate over 2 milli meters of lead, or 12 millimeters of brass They also induce chemical change in organic matter

Gamma rays are not particles of matter but vibrations of the ether similar to ordinary light and to the X rays but of much horter wave length and greater ponetration. They are said to have less power than the alpha or beta rays to produce chemical change

In medical work we may use the three sorts of rays together or by appropriate screens exclude either the alpha or beta rays. Ten per cent of the gamma rays are absorbed by 1 centimeter of tissue. They readily pass through 1.2 millimeters of brass only about 3 per cent being absorbed In passing through metal sercons, however soft secondary both rays are generated ' These may be absorbed by placin, filter paper gauze or wood I continued or more in thickness about mutal screens. In experimental work it is possible by meins of the electromagnet to use the alpha and beta rays alone. Chineally, we can approximate this by virging the time of application and the thickness of the screens beeing of the relatively greater amount of alpha and beta than of gamma rays the proportion is respectively 90, 9 and 1 per cent when no screens are used

Injuries Incidental to Handling Radium -The increasing use of large quantities of radium for therapeutic purposes makes it important to describe the symptoms and signs which may be time do by workin, with or even near radio active substances and to emphasize the importance of these as occupational injuries Suggestions are offered a that more serious late effects may not result

Rutherford states that Walkhoff first observed that radium rays pro duce burns of much the same character as those cau ed by Roentgen rays Experiments in this direction have been made by Cu of Curic and Box querel and others with very similar results. After handling radium there is at first a painful irritation, then inflammation sets in which lasts from ten to twenty days if suitable preciutions are not taken. This effect is produced by all preparations of radium and appears to be due intiniv to the alpha and soft beta rass. Care has to be taken therefore in han dling radium on account of the painful inflammation set up by the rays If a finger is held for some minutes at the base of a capsule containing a radium preparation, the skin becomes inflamed for about fifteen days and then peels off. The prinful feeling does not disappear for two months

Although these rather acute reactions due to radium are apparently well known to physicists working with radio active substances and considerable experimental work has been done on animals by biologists to show the instological changes produced very little attention has been paid to the more chronic changes. With the increasing u e of large quantities of radium attention should be called especially to these changes to which the e handling ridium are sulject. A proper realization of this fact is necessars not only because of the annovance and discomfort can ed by he h a serious effects of radium but because with the analogy of the crious late effects of X ray burns in mand, a warning should be sounded against possible similar results from radium, such as atrophy, intractable ulcers

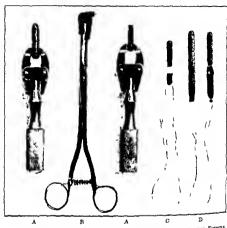


Fig. 1—Devices for Hoteless Brass Capsule to Aroin Covace or sur Everge.

A watchmaker a vise filled out to grasp brass capsule in whi is no cercious size needles five to ten in number are placed. B forcept grasping cover or loss up sule. These devices hold capsule and cover while screwing capsule open of open thus avoiding injury to fingers by repeated contact. O then grable held by strong silk. In this are placed five seven of the needle-contained possible for admin subjished each. D he capsule is the placed some rother fountain processor of of ke ping it clean and in certain material processor from injuring the appendix and in certain materials.

Such an application may be placed within the uterals held in place by galaxing for the continuous processor of the place of the condition treated and the continuous processors.

tion and even cancer Already in certain instances there has been caused not only great annoyance from discomfort but actual impurment in manual devterity in performing delicate manipulations, because of persistent local anesthetic effects

The symptoms caused by bandling radium may occur very insidiously and consist of blunting of sensibility of the finger tips, paresthesia such as increased sensitiveness to heat and pressure amounting at times to actual pain, and finally to anesthesia of varying degrees.

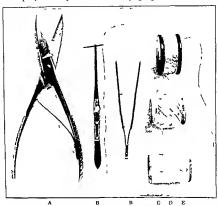


Fig. 2.—Firsting Desices ron Asoprise Covered or Fiveness with Tables. A shear fou of a nement for cutting be t.l. of f. w. e.s a screens and special applicators. B locking forceps to hold radium needle while it is being thread of with strong like by hold; gend of with. m. mall forceps. C.b. ided slik fish line very strong in best f.r. holding cap ble. D. pool of twong crocket with for h ding needles. F. spool of ortine w wing at lib—not tr. no. compt.

The subjective disturbances are out of all proportion to the objective findings which include flattening of the natural ridges on the affected fingers with consequent changes in the characteristic markings of the finger prints thickening of the homy layer of the piderinis with scaling in varying degree failure of the tips of the fingers to resume their normal shape after pressure a sort of pitting upgrowth of the cutcle at the base of and undermeath the nails which tend to stand off from the fleshy part of the fingers and which become ridged easily cracked and extremely brittle
Various general symptoms such as herdache, malaise, weakness under

Various general symptoms such as herdache, malaise, weakness under datigue, unusual need of sleep, increased excitability, fretfulness, irritability disorders of menstruation, attacks of dizzmess, etc. have been



FIG. 3—TRICK SIDED I PAD HOY AND COVER YO PROTECT WORLERS FROM PADIUM PADIATIONS WHILE MAKING AND APPLITIA APPLICATORS In the lead box are a non corrosive steel needle containing 10 multigrams of ra hum sulphate and a brass capsule in which are two aimities radium needless.

gold by Gudzent and Halberstondter to by caused by repeated and long-continued ex posure to radio-active substances Such symptoms art, how ever, common in mans people at times and, is they cannot be ac enrately and objectively recorded, there is doubt if they can be definitely proved to be due to exposure to radium They may be due to close continement, tiring routing and lack of outdoor exercise and other eau es The exposures of some of the cases reported were doubt less large, some of the individuals affected were assistants in 'Fabriks" for manu facture of radium apparatus and some had

two similar radium needles been engaged for ears
during the entire div in work with radio-active substinces. It is, there
fore, probable that certain general symptoms do occur as a result of expositive

Changes in the blood of radium workers were observed by Gudzen and Halberstaedter Most striking was the relative and absolute increase in lymphocytes from 36 per cent to 63 per cent, average of ten cases 464 per cent, a relative and absolute decrease, in neutrophils, average 503 per cent. There was little change in red blood corpuscles slight diminution in white cells and the hemaglobin was lowered in only two cases, 70 per cent and 71 per cent respectively.

Various methods have been devi ed for avoiding the e injurious of feets. In order that the least possible contact of the fingers with the radium may occur, forceps or special vises are used for holding tubes

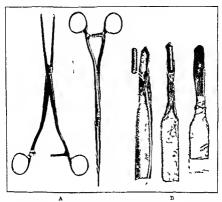


Fig. 4—Devices to a large page value of Ratio STON Son Pascers. A translated again 18 incline in Figure produces and an all old pattern for with 18 liter nade to grap r 1 mm n. H. at x 1 x n. n. and the last last vider to the result of the page 18 incline to the Respectable, and the last vider to the result of the page 18 incline the last vider to the result of the page 18 incline the last vider to the result of the page 18 incline the last vider to the result of the last vider to the last vid

and for optining and closing them a peerd metal losses have been constructed so that the actual tubes mus be affect stored und kept when not actually in use. Special rubber cancel per for contain rs have been desisted in order to wrond wrapping the rudinio mp he hind in best rubber (Fig. 7). Itsoled Jan. Inngers etc. are clum's and as not re ulid worm. of the fungers and which become ridged, easily cracked and extremely brittle

Various general symptoms such as headrche, multise, weakness, undue fatigue, unusual need of sleep, increased excitability, fretfulness, untability, disorders of menstruation, attacks of dizziness, etc. have beautiful.



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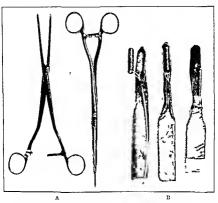


Fig 4—Desicts for Profit into and it Reliferation Surveyance. A tog job immedial Moiss us 16 op per radium of all male fring timing got illustration gis and the fall test better died into that i. B. I that 3 b. I that 4 b. I that 3 b. I that 3 b. I that 3 b. I that 4 b. I that 3 b. I that 4 b. I that 5 b.

and for opening and closin, them portal metal loves have been constructed so that the active tubes may be safely stored and kept when not settailly in use. Special rubber cavelopes for containers have been devised in order to anoid wrapping, for indium my be hand in sheet rubber (Fig 7). Leaded glores hangers etc aire dimess and are not readily worn

In placing active tibes in special applicators it is important to avoid all contact with radium and, as the effects are not apparent at one as when handling very hot objects such as beated glass, but only after a period of dars or even weeks, it will be difficult to train a worker to avoid all contact with the active apparatus. Therefore, in the work of making routine applications of radium there should be a rotation in the staff and persons affected should be freed at least temporarily from such work.

In order to avoid general disturbances, the body should be protected as far as possible by metal screens in the form of lead boxes or place about the radium, there should be frequent ventilation of workrooms particularly if there is radium emanation present, and a change of duty and shorter hours, periodic physical examination of those working with rido-active substances with special reference to the blood examination is

ındıcated

From the above it is evident that marked changes may occur on the fingers of those engaged in routine work with radio-active substance. The e local objective changes consist cheft of flattening of the claracteristic ridges, thickening and scaling of the superficial layers of the sun and civin atrophy and intractable ulceration. These leans are usually slight compared with the marked subjective symptoms, such as pare thesia, anesthesia of varying degree, tenderness, throbbing and even pain. The persysteme of such effects is noteworth.

Various general systemic symptoms and also blood changes may be produced by exposure to radio-active sub times. To avoid such local and general disturbances special protective and presentive measures have been devised and those engaged in routine handling of radio-active sub tance-

are particularly cantioned

Application and Administration of Radio-active Substances-Radium may be used either externally or internally, for re-earth or routine therapy. It may be used as a salt when spread evenly over applicators and retained in position by special variation or the east may be

employed in tubes, needles or in special containers

The emanation or radio-active gas evolved from a solution of radium has the properties of a gas, that is, diffusion, solubility in liquids, con densation, and liquidaction at a certain pressure and temperature. It is also radio active, that is, it ionizes air, di-charges electrical bodies, affects photographic plates, passes through bodies opaque to light, and protokes phosphorescence in different substances and even in the glass which con tains it. Emanation derived from a dilute solution of soluble salt of radium, usually the chlorid, may be freed from the adauxture of hydrogen and oxygen, due to the hydrodysis of water, and reduced to a very small volume hy Duane's method of passing it over a heated copper coil or but may be passed by mercury pumps into capillary glass tubes which are

sealed off into lengths suitable for various containers. The emanation may also be compressed into special containers and used without "purification". It may be set free into special chambers for inhalation or dissolved in water for drinking or for injection.

Radium A, B, C, the so-culled active deposit from the emination, may be used for external application by various applicances or when deposited according to Duane's method it may be used medicinally by in jection, etc. As radium in the form of a salt, such as the sulphate, loses half its strength in a little less than 2000 years it may be regarded as practically constant for therapeutio purposes. The emanation, however, loses half of its strength in 3.85 days that is, it weakens practically one saith a day, therefore allowines for this must be made in treatment. The deposited activity, radium A B, C loses half its strength in one hour Because of the technical procedures necessary for purifying the emanation and for obtaining the active deposit and because of the relatively short period of their activity, these forms of radium are in less general use except in clinics where a physical laboratory is maintained.

The us. of radium emanation bowerer, has certain practical advantages, particularly in avoiding loss of the radium by theft or accident. The solution of radium may be kept carefully locked in a safe while the emanation is constitutly being, formed from it. The emination may be put into containers of various sorts and conveniently, sent away by post It should be borne in mind however that half the strength is lost in 38. days, therefore the emanation can be sent only a limited distance. The disadvantages of using emanation are that it is constantly losing its radio activity as above indicated and it is, therefore somewhat more difficult to apply very exset dosage, which may be important in certain cases.

Action of Radium Local and General -It has been said that radium acts merely as the most expensive and efficient foroi of cautery as yet dis covered On the other hand, it has been claimed that the radiation from radium has a marked selective action in destroying pathological tresue without affecting normal tissue. Between these extreme views however a mean should be taken. While it is true that the alpha, buta and gamma rays do exert a somewhat selective action this however, is only relative, the more embryonic and cellular tissue being chiefly altered By prolong ing the exposure however, even dense fibrous tissue may show changes There is great variation in the effect of radiation upon different growths and also on normal tissues The lymphatic organs are specially sensitive and easily destroyed and also the hair follicles the glands of the skin and the reproductive portions of the ovary and testis. The endothelium of the blood vessels may swell up and cause occlusion of the vessels with marked diminution of the blood supply Cartilage bone muscle con nective and nerve tissues including brain are very resistant to radiation

In many cases it is impossible to predict by histological examination which growths will be easily affected and which will prove refractory to the action of the rays. Although it has been supposed that the action is purely local and direct upon the cells themselves, there may also be an indirect, possibly evtolytic, or other "immunity" reaction secondarily produced. The destruction of tissues exposed to radium is usually be necrobiosis, the nuclea become swollen and acculated, the nucleal become enlarged and fragmented, the straining characteristics of the tissues are altered, and detth of the cell custor. It is believed that the effect of the radiations is to produce ionization of the atoms of the different substances the rays penetrate and that chemical changes follow as a secondary result of the ionization.

After exposure to radio-active substances there is usually a latest period of longer or shorter duration before the effects become cyclet. This latent period varies from one or two days to even two or three weeks or longer. It depends in most instances upon the strength of the source of energy and upon the amount of filtration and protection used. In certain instances it may depend upon personal adiospherase.

The effects of exposure to radio active substances may be either local or general Local effects on the skin may very in intensity from ervibena to vesiculation or ulceration of varying degree and possibly lead to the development of cancer. To these dangers the attention of those engaged in radium therapy is particularly called. General effects such as sterilty, changes in the blood, and constitutional disturbances such as nausea and comiting may occur.

Comparison of X ray and Radium—Although there are namerous physical differences between Roentgen rays and those emitted by radio-active substances, in certain respects they are analogous. They produce similar chemical action on photographic paper or film, they cause fluores cence, they penetrate opaque objects, and have the property of conning the air and so rendering it a conductor of declineit. The similarity between the physiological action of the Roentgen rays and of ridin active substances, particularly if used by the methods, is straining. In general it may be said that the local therapeutic effects of unfiltered X rays produced by soft tubes and low voltage may be compared with rays from radio active substances of filtered through a very thin sheet of paper or aluminum which intercepts merely the alpha rays, that is, unscreened rays with very short exposures of a few minutes are comparable in effect to weak beta rays of radio-active substances with exposure of from fifteen

Radiations will be the term applied to rays particles or electrons derived from radio active aubstances

These have been described in considerable detail by Tvzzer and Ordway in Diseases of Occupation and Vocational Hygiene Rober and Hanson P Blakiston's Son & Co 1916

minutes to an hour. Such rays have comparatively little penetration and are used in the treatment of superficial lesions of the skin and mucous membranes for it is believed that only the rays absorbed produce physiological changes. It is, therefore necessary in order to produce any marked effect on deeper tusines to use screens or filters to check the less penetrating rays which would otherwise be absorbed by the superficial tissues and cause marked destructive changes there, before the less numer ous and more penetrating rays could act on the deeper tissues When using ridium it has been shown that screens or filters (lead 2 or 3 mill) meters thick, brass 1.2 millimeters, or other heavy metals such as silver and cold or platinum) allow the penetrating hard beta and comma rays to pass and intercent the alpha and soft beta rays which would otherwise be absorbed and cause destructive changes in the superficial tissue. It must be remembered in this connection that metals more particularly lead used as filters for rudiations do give off, in a varying degree soft beta the so called secondary rays As the amount of the more penetrat ung rays is only a small proportion of the total activity, less than 5 per eent it is necessary in deep ther ips to make the exposures correspondingly long. Hours are required even twents four, forty eight or longer, for deep therapy with heavily screened apparatus, whereas a few minutes to an hour are used in the treatment of more superficial lesions with radium Fluorescent dyes, colloidal met ils and other substances have been advocated to activate or intensify the action of radiations. They have not as yet, however been proved to be of clinical value

In practical radium therapy radio active substances are in certain cases doubtless preferable to the u c of Pootigon rays particularly when there is necessity for the most price is localization especially within the body or in the cavities difficult of access all o when the condition of the pittents or circumstances demand portability of the therapeutic agent for convenience or case of triatment. The dividuantiages of radium are its great expense for millicrant doses necessary in some cases also the possibility of loss of the salt by accelerator thefit. This may however be obviated by insurance of the radium or by u c of the cumunition as above indicated by insurance of the radium or by u c of the cumunition as above indicated by insurance of the radium or by u c of the cumunition as above indicated by insurance of the radium or by u c of the cumunition as above indicated by insurance of the radium or by u c of the cumunition as above indicated by insurance of the radium or by u c of the cumunition as above indicated by the passibility of the increasity of retaining a physical advances in the production of highly penetrating homogeneous X rays of great volume by Coolidge and his convolvers, supplemented ly careful securities study of the physiological effects, we believe that there will be in the majority of cases every little difference in the therapeutic value of the X ray and radioactive substances.

If radium is to be employed as a therapeutic agent it is important not to use X ray or any form of caustic previously, for the results of radium therapy under such eigenmentances are usually very disappointing

Medicinal Use of Radium —The treatment of so-called medical diseases by radio active substances must be considered even at the present time to be in the experimental stage. The indications and contra indications are not as yet clear nor have the results been sufficiently definite in many instances of supposed cure to judge the real value of the treatment.

Radium may be administered internally as a therapentic agent by various methods. A soluble sall such as the chlorid or bromid of radium, may be injected into the body or taken by mouth or used for hathing. The emanation the radio active gis evolved from a solution of radium, is somewhat soluble in water and may thus be used in the same manner as the osluble sall. In the form of gis it may also be taken into the luigs by various devices—in the small personal respirators, with mouth or nose pieces, in cabinets or in bid or in room emanatoria. Patients remain for hours in some of these, the resulting cerbon dicavid and water vapor are removed by sodalime and sulphurie acid, oxygen is added, and the temperature is controlled by coils as in the calorimeter. The active deposit radium A, B, C, when deposited on salt, may be administered in a manner similar to the soluble salt above indicated. The dosage of the various forms of radium taken internally is, at present, very varietic, sude range having been employed by various workers as below indicated.

Radio active substances may be employed in other ways. In the form of packs, naturally active material of pitchblende residue or artificially active material is used. It has also been given as buths, the water being derived from naturally radio active springs or water to which has been added soluble radium sitt or emanation. Indeed, it has been claimed that the beneficial effects of the waters of extrum well known springs are due to the fact that they contain radio-active substances clinely emanation. When radium or its products are given by month it is believed by von Noorden that there is greater effect upon the liver, as the emanation reaches the heart through the portal venus and leaves the body almost entirely through the lungs within a few hours. When emanation is malied he considers that the emanation goes more rapidly into the general circulation. In the radio active buth of 200 liters the natural radium content varies from 31,000 to 120,000 M. L. (Mache units) or in some

When water is artificially activated, similar amounts have been used When radium emanation is used for drinking, 1,000 M E a day up to 10,000 or, in certain instances, 90,000 M E a day have been given by the German school. They usually begin with doves of 330 M F three times a day and for further treatment proceed to 5,000 or 10,000 M E a day three times a day and in individual cases 30,000 to 90,000 M E a day. The Radium Institute in London, during the year 1914, recommended the

One thousandth of a milligram (a microgram) of radium solution in equilibrium is equivalent to °700 M E of emanation

drinking of at least 14 liter of water activated by emanation containing at least I millicure per liter (a millicure leng equivalent according to the physicist at this Institute to 2 160 000 M E). This would make the dosage vary from 540 000 to 1 050 000 M E daily. It is beheved at the Padium Institute that at least six weeks treatment is necessary before benefit is noticed.

When a solution of the soluble selt of radium is used for drunking or for subcutuneous injection the desage given has varied from 50 to 250 micrograms. The above indicites the very great variations in the desage which have been employed by different observers. Similar variation is seen in the case of emanatorium it attent in which some recommend per liter of air 2 to 4 VE, others begin with the same does and increase to 22 ME and gradually to 45 in special cases to 110 eventually to 220 440 or even 650 ME. You Noorden and Falta have given 1200 ME per liter. Coutand recommends emanation from 2 to 4 milligrams of bround of radium (without accumulation) in a room of 10 cubic meters. He has the patient remain in this room for one and one-half hours. Various devices are now on the market for furnishing water containing emantion. The does is in many instance, small and it is important that the products of appearatis used in conjunction with radium therapy should be carefully analyzed by a competent physicist for the true radium content.

Physiological Action of Emstation —It has been claimed that emaint tion in many patients increases the gracous exchange and the reprintory quotient. In Basedow's discase although the brael exchange is above normal, it may be still further increased by emination. Emstation is thought by some to increase sugar metabolism as well as thit of albumin and purins. The unce acid output is particularly increased by emina tion in cases of gout. The influence of emaination on the blood picture may be striking at first there may be hyperfectablely tools and later a diminution in white cells. There is a relative increase in monounclear cells. It is also claimed that in certain instances emmanation acts as a durertic and it has been said to exert a stimulating influence on the sex glands particularly in cases of acquired impotence or in tabletic or in sentitive. Usees are cited of the return of meastruation after the meno pains and also in certain instances of amenorities. It has also been as served that radio active matter modulies the phenomena of inflammation and attimulates the action of the various ferments — such as the pancreatic, peptits, and lacte acid and the antolytic ferments in the tissues.

Attention has been called to such symptoms as dizzines pressure in the head weakness albuminum and hemorrhages following large does and experimentally it has been found that serious complications may result in animals. With large does also there may be mixed changes in the metabolism and in the blood picture. Such claims have not been Medicinal Use of Radium —The treatment of so-called medical diseases by radio active substances must be considered even at the present time to be in the experimental stage. The indications and contra indications are not as yet clear nor have the results been sufficiently definite in many instances of supposed cure to judge the real value of the treatment.

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range having been employed by various workers as below indicated Radio active substances may be employed in other wis. In the form of pucks, naturally active material of puchblendo residue or artificially activated material is used. It has also been given as balls, the water being derived from niturally radio active springs or water to which has been added soluble radium salt or emulation. Indeed, it has been claimed that the beneficial effects of the waters of certain well known springs are due to the first that they contain radio-active substances, chiefly emass to whom the property of the propert

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One thousandth of a milligram (a microgram) of radium solution in equilibrium is countaint to 2700 M P of emanation

Gonorrheal Arthrits —The results are not favorable although occasionally improvement is obtained on injecting solutions of soluble radium salt in the vicinity of the joints

Tuberculosis of Joints - Results are not favorable

Gout —His reports a large series of ever of gout treated by cmana tion, the unic acid content of the blood is said to be greatly lessened although there is not a complete purillel in the blood content and the

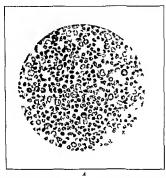


FIG. 54—A BLOOD SMEAR FROM A PATIENT WITH MERLORENDIS LEURENIA TAKEN before Padicial Transferry White blood c unit 500 000 l rge number of miels eyte and inyeloid its a e h n

clinical dringes. Some caves show improvement in the general condition subsidence of joint welling without marked diministion of urice and in the blood. Other cases with gonty nodes, even in periods of the most frequent attacks show no abovernal amount of uric acid in the blood. Many cases under freatment by radium emutions show disappearance of the topla in the cir. Guidzin reparted in hundred et as of goif in some of which he scarred still further improvement by injection of a dilute solution of radium alt. In the beginning of treatment there may be temporarily an increase in pain as the result of reaction. Emmantion may be used both by drinking and by inhalation. Radium should not replace

generally confirmed. It should be realized that the real value of the internal or medicinal use of radium and its products is at present doubt ful, and because of the possibility of harmful effects it is advisable to begin with small does and to be conservative in our estimation of the results.

# THERAPEUTIC EFFECTS OF RADIO ACTIVE SUBSTANCES

Arthritis Deformans (Chronic I heumatism) - 1 he types with evada tion are said to be more favorable than the dry forms. His his reported eases with striking improvement in the general condition. At the Ladium Institute in London, Pinch reports extremely favorable results some times, as he said the results are remarkable. At this Institute, 2:0 cc of emunation solution of a strength not less than 1 millionrie per liter up to 2 millicuries per liter are given to patients suffering from this obstinate, painful, and crippling disease. Pinch says that it is difficult to predict with certainty the degree of improvement likely to occur in any particular case but that the cases which appear to derive most kinefit are those in which the disease is of relatively short duration and the changes are perparticular in type and multi articular in distribution. The age of the patient al o exerts some influence, the e under forty responding more quickly to the action of emanation. Little or no improvement cut be looked for in justances when cartilaninous or o scous changs are predomin int When limitation is due to preparticular fibrons thickenium considerable increase of mobility often follows and enables patients to perform actions such as feeding themselves, ben hing their hur, shavin, etc, which they may have been powerle a to do for some months or even verre. Mn cular and articular pains are k sened or disappear, grating of the joints on movement is not so marked, muscles may regun much of their lost tone, and the pitient's general health may be much improved The treatment must, however, be persisted in for quite a long time, at least six weeks before any change is noted. McCrudden believes that the creatinin metabolism may be influenced by radium emunation water

Acute Articular Rheumatism—In the majority of cases traited by you Noorden it is elumed that emanatorium treatment acts as well as schedulets, the local symptoms subsiding in a few days. Saleculites were used in conjunction with emmation, however, in certain case. The treit ment was from two hours to over might and the doses 220 to 1,200 M. F. Von Noorden and Falti believe emunation is specially valuable in cases which do not stand saleculetes well.

Chronic Arthritis —In arthritis secondary to tente general infections or from a focus in the tonsils, teeth, etc., results are doubtful

Gonorrheal Arthritis —The results are not favorable although occasionally improvement is obtained on injecting solutions of soluble radium salt in the vicinity of the joints

Tuberculosis of Joints - Re ults are not favorable

Gout --His reports a large series of cases of gout treated by emanation, the unce acid content of the blood is said to be greatly lessened although there is not a complete parallel in the blood content and the

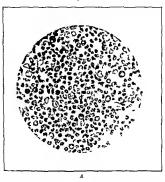


Fig. 5.4—A Bloop Safar from a Patievi with Myelocevous Leuremia Tykev b fore Pania Transless. White H od count 500 000 large number of myelo cites a d myeloblaste are shown

clinical changes. Some crees show improvement in the general condition subsidince of joint swelling without marked diminution of uric said in the blood. Other cases with gon't nodes even in periods of the most frequent attacks show no abnormal amount of uric acid in the blood. Many cress under treatment Iv radium amounted on divelypevarine, of the toplu in the car. Gudant reported in bundred crees of guit in some of which he secured still further improvement by injection of a dilute solution of radium aft. In the beginning of treatment there may be temporarily an increese in pain as the result of reaction. Emination may be used both but drinking and by inhalston. Radium should not replace

treatment by diet and other common aids in the treatment of gont such as hygienic measures, colchieum and related drugs.

Leukemra — Von Noorden and Pulta did not obtain any favorable results by emunatorium treatment in lenkemia but only produced an increase in the blood count. The writers, however, by surface appliations of radium over the culared spleen have, in a series of cases, observed a most remarkable jumprovement and striking changes in the we

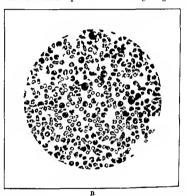


FIG. 5B.-4 BLOOD SUEER FROM A PATIENT WITH MYSTOCKNOWS LEUKSMIA TEST during the Course of Paditin Treatment. There is a market humilition in the number of white bloc level 74 000 the lumination is cheffy in the melablists and myslocytes with a relative increa e in the polymorph muclear leukoyles.

of the splcen, the blood picture, and the general condition of the patient. In the course of a few weeks or, in stubborn cases, in three or four months after treatment by the surface application of radium according to the method described in this artick, a splcen which filled almost the entire abdomen, extending well to the right of the median line and into the pelus and canain, marked pressure symptoms, his been reduced to normal dimensions so that it was not pulpable below the costal margin. Hood with white coints of from 500,000 to 700,000 became 6 000 to 8,000. The immature forms of white cells—the myeloblasts, myelocites—are is

pecially affected. The hemoglobiu increased from 40 to 70 cr even to 80 or 90 per cent. The red blood-corpuseles increased from 2,000,000 and 2,500,000 to 4,000 000 and 5 000 000 indeed the blood picture often approximated normal. A pik cmartated anxious individual with prominent bony framework stooping shoulders and enormously enlarged abdomen usually loses the anxious expression becomes plump the abdomen returns to normal size, the color and trength improves so that the pittent

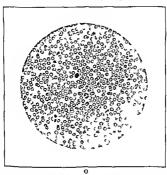


Fig. 5C—A Blood Smelr from a Patient with Mielodytots Leurenia Takev
off the Counc of Rading Transment. The myelovies have entirely dis
appeared the white count is \$00 con six the variation in size and shape of the
red cells persist honever.

max ful entirely well. The pathological condition however sooner or later is apt to relapse gradually and the respons, is less prompt in subsequent series of radium treatments although eases have been kept in good condition for a period of one to four years by occasionally repeating the radium treatment. Numerous cases however have deed of intercurrent infections or have succumbed to the original disease. Although these results in the radium treatment of luckerms are most striking in the chronic new plogemous variety in certain cases of lymphatic leakens; results are almost equally good. It must be understood however that the results should be regarded at the prevent time mertly in the light of palliation and not as cures.

It is hoped, however, that future research will at least increase the duration of these remissions. Although the treatment must not be considered at the present time as curative, from the results obtained it is the best form of treatment now at our disposal. Certain of the cases which respond promptly to radium applications over the spleen had previously proved entirely refractory to prolonged. Yars, and to leave trainent.

It is to be noted, however, that in the surface applications of radium above described the results were obtained without radiating the long bones, in fact, in one instance in which the long bones were radiated there was apparently, an increase rather than a diminution in the white cells it is also believed that the results are more prompt by the radium treatment than by Ara's as lutherto employed, and no case has been ecompaned by severe toxic symptoms, although there is a marked increase in the endogenous purin metabolism. On a purint free diet, who said, urea sad total nitrogen in the urine are markedly increased.

Miscellaneous Conditions -In a few cases of croupous pneumonia it is claimed that the temperature began to fall earlier than usual and by lysis and that the dissolution of the evadate was strikingly rapid The symptoms, such as difficulty in breathing were markedly relieved in the emanatorium in which 100 M L of emanation per liter was used In certain instances the patients remained in the (manatorium over night In diabetes mellitus the effect upon the sugar metabolism is not constant but the emanation theraps is said to affect favorable diabetic neurits. In certain cases of neuralgia neuritis, and sciation, it has been claimed that the condition has been benefited Claims have also been made for favorable therapentic effects in the case of arteriosclerosis certain kidney dis cases and even in takes dorsalis, in the latter matrice more particularly in relieving the so-called lightning pains. In some cases of syphilis in which a positive Wasserman perusted in spite of active and prolonged treatment intravenous injection of from fifty to two hundred and fifty nucrograms of radium chlorid solution at intervals of a few days and later once a week resulted in the reaction becoming negative in certain instances It would seem, however, that there has been much exaggeration of the value of radium in many of these chronic conditions

The indications and contra indications for the internal use of radium are vague. The value of the medical uses of padnun has been greatly exage, crated and reports are confusing. The grait variations in dossed add to this. There seems no question, however, that benefit has been derived in certain forms of gout and chronic plant variations in dossed effect upon the hematopone to issues, where adjuntative or destructive, must, however, be lorne in mixed. Hippone with this also been reported in cases of perficious anemia or rythfrey thermal and in hypertenson. In the latter the blood pressure is said to have been reduced to normal and the subjective as implicits as and to have desapped and

Internal therapy by radio-active substances is still too recent and poorly controlled to expre s a very decisive opinion regarding its value. The duration of favorable results reported is not known in most in stances. There is need of more control cases and of a large number of cases worked up in detail treated by different methods and followed to end results before certain conclusions may be drawn.

External and Surgical Use of Radium - The value of the so-called surgical use of radium is much more definitely established than its medic insluse Even the most conservative and careful clinicians who have had any extended personal experience with adequate amounts of radium rec ognize its value and limitations when used in certain surgical disea es In a large proportion of this class of cases, surgers is undoubtedly pref crable and radiations if employed at all should be used not to replace but, in many instances, to supplement surgical procedures. We believe that many of the extraordinary claims have prevented a proper estima tion of the true value of radium therspy, both by the profession and the This has been due to the fact that the exceptional cases in which there has been great relief or even cure have been reported as if they wem the rule In describing the limitations of radium therapy the fact must be taken into account that there are from time to time very exceptional cases particularly of malignant tumors some of which have re pestedly recurred after numerous operations and also cases that have been entirely inoperable which have apparently vielded to radium therapy While the careless or the overenthusiastic physician bas described these cases as if they were the rule vet it is by studying them most carefully and becoming acquainted with as many of the factors involved as nos sible that we may hope that these now exceptional and unusual cases may become more and more frequent. It is thus also that we may expect truly to advance the progress of radium therapy. In describing conditions in which radium therapy has been used it is difficult to follow a systematic or logical arrangement either from the point of view of path ology, etiology or anstoms Therefore both anatomical and pathological arrangement will be made use of

Methods of Application —It is almost impossible to give detailed rules for the application of radiations. The ource of rulation for therapentic use should be not only physically but physiologically standardized under the exact conditions in which it is to be employed. The direction, smount of radio active element fiftration distance and in ortain instances the individual variation of the subject of the experiment must be considered. The great variation in the reaction of different tumors to the radiation has been pointed out by Werner. In practice 11 has been found of the utmost importance to use the method of physiological stindardization not only for becoming familiar with the various changes produced in animals but in the tissues of man subjected to radiations. For example

in order to apply radium intelligently for therapeutic purposes, it is necessary to establish a so called 'erythema dose,' that is to determine the tolerance of the skin to the various radiations under the conditions employed

The degree of the acute reaction following the exposure is very variable depending upon several factors, namely, the intensity and quality of the radiation, the duration of the exposure, the part of the body exposed, and the individual sensitiveness or tolerance. Gooth claims that there is no special idiosvinersy as was at one time believed. The intensity and quality of the rays depend on the amount of radio active substance, the distance it is from the patient and the fiftration employed. The effects depend on the rays absorbed by the tissue. The therapentic indications and effects of the X-rays and radio-active substances are almost identical when employed by similar methods.

Numerous refinements of the technic of radium application have been suggested, and while some of these may facilitate the more exact fixtuation of the radium to the area under treatment, just as good results may be obtained by simpler applicators, if due care is taken. For the treatment of lesions about the face or mouth, molds of dental wax may be in dem which the radium is embedded. In some clinics where emmantions are used, capillary glass tubes or "seeds" containing minute quantities of this form of radium are hirred in the diseased tissue and left there. Since the introduction of needles continuing radium element however the same results may be obtained by unserting the metal needle and withdrawing it by a thread attached to the eye of the needle, after the desired length of exposure.

Unusual technical methods such as having the radium rotated by a clocklike mechanism so as to diffuse the rais, on the theory of more even distribution, do not seem to offer any practical advillage in treatment

The strength of radium depends upon the amount of radium element stated in milligrams of radium or millicuries of radium emanation per hour, per unit area. A millicurie is the quantity of emanation that furnishes the same penetrating radiation that I milligram of radium element produces. The dose employed in the external and the so-called urgical use of radium insually varies from 50 to 200 milligrams, in certain instances I or 2 grams have been used. The smaller doses are employed chiefty in superficial skin lesions, the larger for large growths deeply situated.

Tabes, needles, and surface applicators containing radium are used on patients according to the following general rules to which, however there are many exceptions. These rules indicate only single applications and can give no idea of the total number of applications or of the time elipsing between them.

The number of applications varies greatly with

the variety and size and extent of the lesion and the intervals are, in most instances, from four to six wocks although, in certain cases applications are made every day or two for a week and then, if necessary repeated at the regular four to six weeks interval. The most obvious in provement usually occurs after the first or second application which should, therefore, be of sufficient intensity to produce the best results alterplated and the stream of the produce actually harmful destructive effects. Small superhead lesions may require ouly a single application of a hif bour to one hours a furation. The time of application depends not only on the strength of the applications. In the time of application depends not only on the strength of the applications as above indicated but also on the size, and nature of the lesion the area to be covered and the sensitiveness of the patients kin Cirtui technical details of application are illustrated in the seconting illustrations (Figs. 1, 2, 4, 6 and 7).

#### GENERAL RULES FOR APPLICATION OF RADIUM

(The following rules apply when an average of one hundred milligrams of radium element or its equivalent emanation are used)

1 Effects on Pathological Processes Beneath Intact Skin —Surface application—screening or ditration 2 to 3 millimeters of lead or equivalent, protection from secondary radiations gause or paper, wood, distance, and rubber. exposure four to six hours or less

2 Superficial Skin Lesions — Such as keratoses small growths etc Screening gono or 01 to 05 millimeters of shuminum or lead, protection agrised secondary radiation none or rubber cover to keep applicator clean adjacent normal skin carcilults protected by a shield of 1 to 3 millimeters of lead cruize and rubber accounts to municies to two hours.

millimeters of lead gause and rubber exposure ten minutes to two hours.

3 Deep Skin Lessons with Ulceration—Screening none or rubber cover for Leeping applicator clean protection of adjacent tissue as in No 2 exposure two to four hours. Note it kason is extremely deep or very extensive screening 1 to 3 millimeters of brass or lead and rubber exposure four to twiche bours or evi houser.

4 Lesions of Mucous Membranes when Superficial —Same as No 2 except exposure of one to two hours

5 Lesions of Mucous Membranes when Deep and Growths Beneath Mucous Membrane —Samo as No 3 except expo are twelve to twenty four and forty-ci₀lit hours durition and in exceptional instances somewhat langer

6 Introduction of Radium within Growths—(a) For deep effect tubes with sericuling of ½ to 1 millimeter of silver or platinum. Exposure four to forth eight hours depending upon size and natifier of tumor average, tache to twenty four hours. (b) For local destructive effect.

nu order to apply radium intelligently for therapentic purposes, it is necessary to establish a so-called "erythema dose," that is, to determine the tolerance of the skin to the various radiations under the conditions

employed

The degree of the acute reaction following the exposure is very variable depending upon several factors, namely, the intensity and quality of the radiation, the duration of the exposure, the part of the body expo ed, and the individual sensitiveness or tolerance Gocht claims that there is no special idiosyncrasy as was at one time behaved. The intensity and quality of the rays depend on the amount of radio active substance, the distance it is from the patient and the filtration employed. The effects depend on the rays absorbed by the tissue. The therapeutic indications and effects of the X rays and radio-active substances are almost identical when em ployed by similar methods

Numerous refinements of the technic of radium application have been suggested, and while some of these may facilitate the more exact fixation of the radium to the area under treatment, just as good results may be obtained by simpler applicators, if due care is taken. For the treatment of lesions about the face or mouth, molds of dental wax may be made in which the radium is embedded. In some clinics where emanations are used, expillary glass tubes or "seeds" containing minute quantities of this form of radium are buried in the disea ed tissue and left there. Since the introduction of needles containing radium element, however, the same results may be obtained in inserting the metal needle and withdrawing it by a thread attached to the eye of the needle, after the desired length of exposure

Unusual technical methods such as having the radium rotated by a

clocklike mechanism so as to diffuse the rays, on the theory of more even distribution, do not seem to offer any practical advantage in treatment

The strength of radium depends upon the amount of radium element Therefore, in reporting cases the dosage should be accurately tated in milligrams of radium or millicuries of radium (manation per hour per unit area A millicurie is the quantity of emanation that furmshes the same penetrating radiation that I miligrum of radium element produces

The dose employed in the external and the so-called sur gical use of radium usually varies from 50 to 200 milligrams, in certain instances 1 or 2 grams have been used The smaller doses are employed chiefly in superficial skin lesions, the larger for large growths deeply estmate d

Tubes needles, and surface applicators containing radium are used on patients according to the following general rules, to which however there are many exceptions. The c rules indicate only single applications and can give no idea of the total number of applications or of the time clapsing between them The number of applications varies greatly with

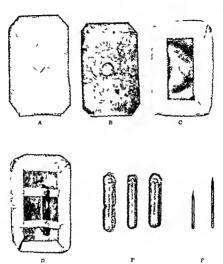


Fig 5.— Equipment you Inserve what the reserves at Laston or the Serve 1 per of the Iron to evide men to be to be the best to all a prevent contains not less and extend e

unfiltered tubes, one to two hours up to twelve hours, length of time depending upon size of growth and reaction desired. Unfiltered needles (10 milh, rains each), response for three hours usually causes necess without liquefaction and is a most useful method when the needles are venily placed. Capillary gives tubes containing 2 milheuries of emans ition, inserted into the pithological tissues by menus of a trochar, an allowed to remain, the ensuration undergoing slow decay and the gls simbles becoming meaning the high length of the pithological tissues and the gls is tubes becoming meaning the pithological tissues.

Further Details of Application —I or deep effects when 2 to 3 mill meters of leid or equivalent are used for filtration, the skin if intert, is protected from the action of the accordary, less potentialing asy by fifter to twenty layers of gazz, paper, or by distance. In practice, radium applications are wrapped in a thin sheet of rubber to prevent solling the rubber containers being changed with each pitter. In order to fisten the radium in place and to secure exact apposition which is so necessary for successful results, double-could adhestic plaster, such as is used in the Wickham and Degrais clinic in Paris, has recently been advocated by Toucey and is of great technical aid in ridium therapy. Supporting buildages, espectify of the four tail variety, are useful in relieving the tension on adhesive plaster and holding the radium pack in place. Satisfactors sterilization of tubus and needles is secured by sorking them in full strength lasd or errobic acid, then wishing, then of in alcohol and putting, them in bone and solution until used. I or cleaning Classid recommends soaking the tubus and needles in equal parts of animonia and perovid, this quackly removes the dried blood or the dull apprevance, then transferring to alcohol and to other, which rapidly dries the tubes and needles before they are put away. We have found this method of great assistance.

Protection—In treating superficial Itsious particularly small lesions of the skin, by radium, it is necessary to use a sheet or mask of lead 1 millimeter or more in thickness, with guize or paper beneath it, or a cost ing of ribber with a hole cut in the sheeld slightly smaller than the lesion to be treated. A harness or earl punch is more convenient than a knife for enting the opening in the sheet lead. Through the opening the lesion may now be exposed to radium and the adjacent healthy skin thus protected.

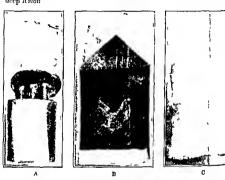
ross fire.—The principle of the so called 'cross hre' is important for successful application of radium to large growths or to deep-scate lesions. The method was first described by Dominici and his since been claborated by others, notably in the trainint of uterin fibroids by X ravs in the Treiburg clime. The run is to concentrate as much of the action of the rays as possible in the deep-scated lesion, with the least possible in the deep-scated lesion, with the least possible angury to the overlying skin. This may be accomplished by employing small tubes of rudium scattered throughout the tumor mass or by surface

a skin pencil or grease paint the outline heing indicated by percussion and palpation. Then the various landmarks such as the costal margins, anterior superior spine of the ilium the symphysis puhis and the umbilious are also marked. The patient is photographed in an erect position in both frontal and lateral views A series it small squares about 3 centimeters in diameter when the radium applicator is 2 centimeters in diameter, are marked over the area of enlarged spleen. It is important not to have the successive application areas too near to ether or the skin between will be burned by the double dose. The squares are numbered serially. Tracings are now made on tracing cloth which serves as a chart for guidance in following the series of treatments \ \ swathe of thin cotton is carefully fitted to the abdomen and the outline of the enlarged spleen bony lund marks and small squares is traced upon it. This swathe is left in place during the single series of treitments. The purpose of the swathe is to avoid the irritation of repeatedly applying and removing the adhesive plaster which holds the radium applicator in place. It has been found that the area which is being or has been radiated is pirticularly sensitive to injury from the repetted application and removing of adhesive plaster. The added irritation may induce vesiculation or even superficial ulcura tion of the skin

With the chart as a guide the radium applicator screened with 2 to 3 millimeters of lend or brass and fifteen to twenty thehene is of filter paper and wrapped in gauze is now applied to the squares in the order indicated. It is necessary also to add at leave as much filtration and protection to the external said of the applicator for the patient may in advertently bring some other part of the body in contact with the applicator during sleep and serious burns may result. In this second erios of treatments which is usually necessity in four to six weeks, applicators are similarly applied. A new as withe and tracing should be made at each strice. The duration of the application in each area with 50 to 100 milligrams of radium is four to six hours. An amount of radium as small as 22 milligrims has reduced a greatly enlarged spleen to normal size and caused the characteristic improvement in the blood and general condition of the pitient but the time required is longer and the applications must be more numerous.

The importance of the distance of the radium from the skin is well shown in the lill traiter of flurmin. He compress a tib. I millimeter away from "tioses and jo have be one minute with the same tube 1 inch away that "atton of rifn some in would require 2.0 times 25 or 0.25 minutes to produce. Let by in rusing the distance however the difference in intensity becomes less for parts below the surface of the skin but it would be nece sury to mera e greatly the duration of application as above indicated or the amount of radium if radiation at a distance were employed for filtration

applications of heavily screened ridings to a large number of areas on the skin so that each area will not be exposed too long or too intenely, a result which would follow the application of the ridings to a single area for the time necessary to produce the desired result on the underlying lesion. By this cross fire method enormous doses may be applied to the deep lesion.



110 7 — VPPLICATOR FOR TREVITUD DEST SCATED I STATE AN AN AREAS APPLICATION THEOLIGIT FIRE SERV MIDE THE LATTRE IS INTERCAND DIFFE BUT NOT SCHARE FEFFECT FOR DESIRED A three brass cap uses containing repected, four ten and four radium needlies in a lead box 725 or 735 medies that. It the latter is slipped into an envelop made of the more tube of a motor cycle time. The cover of this lead by a und the flap of the radius renedop are belt by adherence plaster. C gains fundage is folded into cunts or thirty trevers and placed over the applicator for comfort of the patient and to and in any ling injury to the skin from secondary radiations from the lead. This effect may also be secured by filtration by distance by means of a woolen block but gaux and I it set are more comfortable.

Deep 7 herapy—Cross fire as above described, in order to be success ful on deep sented lessons beneath the skin, requires strong filtration of the rys. The technic of the so-called dkep theripy, which should be used when the greatest effect is desired on deep-bring disease processes, may be illustrated by the striking result of radium when applied in the proper manner to the surface over the enlarged spleen in cases of myel Tho area of the enlarged spleen is errefully and planly marked out with

# GENERAL RULLS FOR APPLICATION OF RADIUM 569

or other forms of operation are attempted to clo e the wound deep recur rences are thus obscured and cannot be treated in time. The superficial lesions treated by radium require from one-half to a few hours exposure, while the deep lesions require twelve or eighteen hours or more the ulcers affect mucous membranes the results are less favorable

Emtheliomata.-In some epithiliomata of the skin the results of

radium therapy are cura tive In the fleshs (basal cell) type of carcinom's called by the French 'cartinome bourgeonment the results are remarkable Large growths melt away under the influence of radiations The success of this treatment depends largely on the careful and frequent cleansing of the lesion between the series of

treatments

Lpidermoid Carcino mata -As these grewths are apt to metastasizo early it is unwise to attempt their treatment by radiation There should be prompt and complete excision unless the location or stage of the discase contra indicates cases which are monerable because of their extent or in those which have recurred after operation the results are rirely if ever curitive

TREATMENT (From S mp on C V Mo by Co ) although occasionally radia tion may be of palliative value Poentgen Pay Lesions - Poentgen ray lesions of the skin, such is fissures keratoses and early epithelioms, are cured or greatly benefited by the application of radium Deeper lessons however, demand excision

or amputation Papillomata Verruce and Kernlases - When Lerato e are present the results are much more rapid if the heaped up horny material is removed by salicylic acid 10 to 20 per cent in flexible collodion. The acid as thus held circumscribed and may be left in place for twenty four hours.



TIG 9-PATIENT IN FIG 8 AFTER PADIUM

For deep therapy in the natural orifices and cavities of the body, radium applicators are protected by rubber covering in order to preven the more local effect of the secondary rays as well as for keeping the applicators clean. Such treatment may be applied at one sitting or intermittently within a few days. There should then be in interval of frour to six weeks during which the priticit should be observed and the radiated area cared for by surgical cleanliness. It should be noted that as a rule, the inavinum beneficial effect is obtained with the first treat ment, which should be the theoretical optimum dosage.

## EXTERNAL USE OF RADIO-ACTIVE SUBSTANCES

Diseases of the Skin —In the field of dermitology radium therapy has been most extensively used and is a most important therapeuta again.

**Redn't Highers**—These silens**



Fig 8 - Frithelioma of Right Ear. (Fi Simpson ( V Mosby Co )

are most amenable to radium theraps, particularly the more superficial forms which have less induration and do not involve bone or cartilant Results of radium are much better in cases which have not been previously subjected to meffectual and mus applied doses of Aray or to causties solid carbon dioxid. ionization, etc Extensive rodent ulcers, involving bone and carti lage, with hard brawny edges, are very intractable to radium therapy, but in a few instances in which large doses have been used and particularly when combined with very careful cleansing and dressing of the area and by allow ing a sufficiently long interval to elap e between the intensive treatments, the results of a few years adres strongen greatly im proved rapy, whicases exten ive operation even when the entire process cannot be removed, as of value when the operative wound

is left open sometimes for many months as advocated by Greenough so that the first sign of recurrence may be observed and radiated. If kin flaps

or other forms of operation are attempted to closs, the wound deep recurrences are thus obscured and cannot be treated in time. The superficial lesions treated by radium require from one-half to a few hours exposure while the deep lesions require twelve or eighteen hours or more. When the ulcers affect mucous membranes the results are less favorable.

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Emdermoid Carcino mata -As these growths are apt to metastasizo early it is unwise to attempt their trentment by radiation There should be prompt and complete excision unless the location or stage of the dis ease contra indicates. In eases which are inoperable becau o of their extent or in those which have required after operation, the results are rarely if ever enritive although occasionally radia tion may be of palliative value

Fig 9-Patient in big 8 after Radium Treatment (bross Simps o C V Moly C )

Poentgen Ray Lesions —I centgen ray lesions of the skin, such as fessures keratores and early epitheliona are cured or greatly benefited by the application of radmin. Deeper lesions however demand excision or amountation

Papillomata Verruca and Kerato es — When kerato is are present the results are much more rapid if the heaped up horaly material is removed by salicyle acid 10 to 20 per cent in flexible collodion. The acid is thus held circumscribed and may be left in place for twenty four hours. On removing the collodion the remaining pipillomata or verrica usually respond quickly to radium therapy in one or two treatments



FIG 10 -KYLOID OF BACK OF NECK RECURRENCE AFTER SURCICAL RF MOVAL. Patient referred by Bayard Holmes (From Simpson C V Morby (a)

are employed and great care is



big 11-PATIENT IN LIG 10 AFTER PADIUM TREATMENT (From Simp son C V Mosby Co )

Lelatds -- 1 reellent results are usually obtained in keloids following wounds, operative or otherwise, or as the result of burns The anesthetic effect in punful keloids may be marked Treatment should not be too inten e and must be continued over a considerable period, usually for months

Contractures, War Injuries-Radium has been used successfully in the after-treatment of old war muries, such as punful sears and fibrous adliesions in joints and about tendons Except when there is extensive and deep scarring, as in the thigh where fairly large doses are required, just as good results are obtained by smaller and more frequently repeated doses

Lupus Vulgaris -The results in some deep scated cases treated by radium are good. Very short exposures necessary Tinsen light, however, 18 undoubtedly best for the routine treat

ment of lupus vulgaris

Lupus Lrythematosus -The results of radiations are variable but occasion ally may be satisfactory, particularly in obstinate cases

Lichen Planus -Patches of this condition usually vield to radiations in one or two treatments and there may be no recurrence

Pruritus -Short unscreened ex posures may produce marked rehef of The results are particularly good, according to Pinch, if the condi tion is associated with definite lesions such as leukoplakia or hyperkeratoses, but not so hopeful if the condition is a neurosis

Ingioneurotic Edema.—Cases of this condition are reported in which considerable benefit and even cure resulted from the use of radiation Nevi and Ingiomata. The value of radiations in the treatment of

### GENERAL RILLES FOR APPLICATION OF RADIUM ..71

nevi is variable. Treatment must usually be prolonged for months in the most careful manner. In superficial nevs more can be expected if blanch ing of the tissue is accomplished by

gentle pressure. The fleshy eavernous nevi in many instances do well under radiation, although, if pulsating the results are more successful of the blood vessel is previously ligated. In many cases the treatment must be extended over a long period

Miscellaneous Diseases of Skin --Favorable results of radiation have also been reported in the following condi-83 cosis favus hypertrichosia alopecia arcata, tinea tonsiirons hyperi drosis seborrhea acne rosacea comedo psoriasie and chronic rezema

Brain -There is undoubtedly limited field for the use of radium in conjunction with surgery in the treat ment of cleeted cases of brain tumor

offers indisputable proof that radium emanations arrested the growth of the tumors and in all probability destroyed them The cases cited have remained well for six seven and eight years respectively

Diseases of the Eye - Carcinoma of the eyelid -Circinoma of the lid even the epidermoid variety usually responds in a remarkable manner to radiations and becan e of the possibility of exact apposition of radium it is preferable to any other form of treatment result of radium therapy is usually curative and the unnightly deformity and secondary conjunctivities and its possible sequela are avoided lid remains flexible and smooth and there is practically no los of tissue except at the exact site of the growth



-LLPI S VELOVEIS OF PROUT CHEEK IN CARL AGED 13 (Taken from Rad um Theropy by Frank Edward Sump on C V Mo by Co 192 )

In a series of twenty four cases of brain tumor thus treated Frazier reports three in which clinical evidence



13 -PATIENT IN FIG 1 AFTER PADIUM TREATMENT (From Simp an C \ Mobs Col

The cosmetre effect is good Opacities of the Cornea and Lens -Improvement has been reported



FIG. 14—CATENOUS ANCIOMA OF FOREHEAD Photograph taken March 1918 (From Supp on C V Mosby Co)
FIG. 14—PATIENT IN 1:0 14 AFTER PADIUM TREATMENT Photograph taken September 1919 (From Suppson C V Mosby Co)



16 17 PIGMENTED HARRY NEXUS OF LEFT ETERBOW AND FOREHEAD (From Simpson C V Mashy Co)
Fig. 17 —PATIENT IN Fig. 16 AFTER REDULK FREATHENT (From Simpson C V Moshy Co)

in cases of opacity of the cornea and lens but more experience is necessary before definite conclusions can be drawn

Diseases of Mouth Nose Throat and Ear - Tuberculosis and new grouths in the month, nose and throat are usually resistant to radium therapy. In certain instances sarcoma even if of large size may dis appear but recurrence is usual. If operable such cases should receive surgical treatment Occasionally new growths of the tonsils may respond quickly to radium therapy even when the glands of the neck are involved Such growths have usually recurred The results are better if the tubes or needles of radium are inserted directly into the growth. In tuber culosis and carcinoma of the larung ridmin therapy may give relief but the benefit is only temporary. The exact apposition of radium, as well as the safety of the patient, is last secured by preliminary trachectoms In certain justances in which the growth is small and localized particularly in the case of papillomata good results have been obtained by the use of ridium. In carcinoma of the cophagus radium application may cause temporary improvement

Leukoplukia of the buccal mucous membrane reacts variably to ra dium. In some cases a lesion quickly disappears but it is apt to recur In other instances at is refractory to radiation. Leukonlakia is often followed by carcinoma particularly when the origin appears to be syphilitie

In carcinoma of the tonque the results of ridium therapy are not usually good and the treatment may be attended by added suffering. In certain instances however the burying of strong tubes of radium in the growths of the tongue has given more favorable result. In one instance, a circumscribed growth of border line malignancy with deep papillary projections in a woman considerably past middle age a tube of radium was buried in the growth. The latter completely di appeared and there was no recurrence. In another case of proved caremoma of the tongue, after incomplete local excision the residue was treated by radium and there

has been no recurrence for even years In the assopharynx and in the accessory sinuses in exceptional cases remarkable results may be secured in inoperable or recurrent sarcoma In carcinoma, however, in the c regions results have not been satisfactory In the majority of cases epithchal growths on the lip are regarded as strictly surgical and this is doubtless the safer procedure. The der matologist however recognizes two types of epithelial lesion of the hip the circumscribed superficial type with slight or marked ker ito es readily responds to ridium. The deeper type even in the very early stiges, should

be treated by radical excision Carcinoma or keratons of the ear if involving the cartilage may prove very resistant to radium treatment and may also be very painful

The results are variable depending upon the size and extent of the growth



FIG. 14—CAVERNOUS ANGIOMA OF FORFIRED Photograph taken March 1918 (From Sumpson C V Mo by Co)

Fig 1 —Patient in Fig 14 Aprex Radium Treatment Photograph taken Septem

ler 1918 (From Sumpson C V Mosby Co)



FIG. 16 —PROMENTED HARRY NEVUS OF LEET EXTERNOW AND LORPHFAD (From Suppose C V Mosby Co)
FIG. 16 —PATIFYT IN FIG. 16 APPER RAIGON TRATMENT (From Sumpson U Mosby Co)

been radiated Unless the dosage is well understood, however, the danger of treating such cases must be borne in mind and this is particularly important when such good results are obtained by surgical methods

Thymus—Emmently satisfactors results have been reported in the treatment of enlarged thymus glauds in infants. The same results may be obtained with the X rays but radium has certain advantages. It is

Pathological Conditions of Chest -Individual cases have been cited and apparently corroborated by radiographs in which radiation has caused the disappearance of thorsese tumors especially in the case of lymphosarcoms Hodgkin s discase involving the bronchial glands and lungs bas not in our experience shown any permanent improvement on radiation carcinoma of the esophagus it is dif ficult to secure accurate apposition of radio active substances but in the majority of cases there is marked temporary improvement Patients who are almost in extremis from starvation may gain thirty to forty



Fig. 19 —PATEMY BY ITO 18 STEEL RADIUS TRANSTREY PROTOSTRAL LAW TO THE PROTOSTRAL LAW TO THE PROTOSTREY AND THE PROTOSTREY AND

pounds This is probably due to the repeated dilatation of the esophagus and to the anesthetic effect of the therapy. Pecurrences however are usual. It is possible that application by instruments allowing direct observation may improve results particularly in early cases.

Diseases of Breast—The most important disease of the breast which is subjected to radium therapy is the recurrent carcinoma. It is the general opinion that all operable miliganat and being timors of the breast should be operated upon. Therefore recurrent or importable growths form a large part of the e treated by radium therapy. The minority comprise a few persons who either absolutely refu coperation.

In tuberculous of the ear improvement is usual although the condition is obstinate. It has been elaimed that small doses of radium have caused marked improvement in cases of oloselerosis that the hearing and also such symptoms is tunnitus have improved. Other than the improvement that may follow from the encouragement that something is being done, we have seen no such favorable results.

Pathological Conditions of Glands—In lymphoma and Hodghins disease the involved glands may be reduced in size by radiation and in cer



Fig. 18—LTMI HOSARCOMA OF NECK Photograph taken July 1919 Note scar of previous operation (From Simpson C \ Mosby Co)

tain instances the disease seems to have been restrained Cures are very doubtful and recurrence is usual Kelly and Burnam, however, report 65 per cent of tweuty five cases of lymphosarcoma treated by radium as apparently cured and believe that in this disease radium should be used. even in the early stages, in preference to surgery In metastatic carcinoma of the cervical glands, the swelling may be reduced in size, painful pressure may be relieved and the tissues become dense often appears as if in ecrtain instances the progress of the disease was checked by such radiation, but owing to the great variability in the natural course of the primary disease this is doubtful In certain instances large primary or secondary malignant growths disappear under the action of radiations and at the same time the general bealth of the patient rapidly fails and

death may ensue A case of enormous kenoly mphagnoan of the critical and subclavicular region in an infant three months of age is reported by Dominici, Cheron, and Birbarin to have completely retrogressed in seven weeks after the introduction for twenty four hours of a vilver tube 1/2 millimeter in thickness containing 50 milligrams of pure sulphate of radium

In certain instances being timors of the thyroid or large goiters have of the thyroid is only in rare instances favorably influenced. Temporary relief of distressing symptoms may occur. In cases of exophthalmic goiter especially when the thymus is molved, great improvement may result after radiation. In certain instances the region of the thymus alone has

which very frequent aspirat or way necessary, was treated personally by radium applications to the abdomen and the assites recurred less and less frequently

It is probable that surgery combined with careful application of radia tion would greatly improve the present results in abdominal disease

Pelvic Diseases - I ectum - In common of the rectum particularly adenocarcinoma just above the sphineter Burnin reports that some cases are definitely curable and that in other there is marked improvement under radium treatment, deep caremomatous ulcers of the rectum are not improved, although polypi mix do well. Certain of the squamous-cell carcinomati about the anns are much improved by radiation and others are less so Preluminary colostoray is advisable

Bladder - Chronic nicers of the bladder may be improved by radia tion, and also publicomate although in the latter fulzmention is probably preferable. The popullary type of executions is more favorable than the squamous-cell variety. In applying ridium it is better to open the bladder

and thus make more exact application for the requisite time

I restate - It is reported that hypertrophy of the prostate is amproved on certain instances. Annurous cases have been reported. In our experience caremona of the protate has not been cared. Farger doses and letter methods will doubtles cours more far mable results. Bugber claims better results from existence of the prostate suprapubually destruction of the cancer by radium needles introduced through the prostate from above ele e to and proalled with the orethra and from needles introduced into the prost he through the perneum and late surface radium applications accurately made while drainings is maintained. Application to the prostate through the restman a also adsuable. The term curr should not be used in these exce

Festicle - Embryomata of the testicle particularly the cellular socalled round-cell sarroma may said to radiation even when the regional plands are involved. By now have under observation in apparently perfeet health a sonne adult in whom there is no um of recurrence even though the mentional glands were involved when the testicle was removed

, and radiation started two vers a.o.

A great deal has been written particularly within the last few years concerning the value of radium to itiment in genecology. Indeed the subject has been taken up by some of the foremost generologists in this country and more a pseudly in Furope Mont ten years ago some of the European genecologists made a tennency statements regarding the beneficial effects of radium in cancer of the uterns but some of these er_mede the mot despara_ing remarks concerning its use subtedly has a large field of u efulne a in general igs

tablained depend in a lirgy measure upon the in and the accuracy of the applicate a to the lesson or whose general condition will not permit an operation and those who are treated postoperatively in prophylaxis of recurrence. In the last class of patients it is difficult to estimate the value of such treatment until a very large number of cases has been exrefully followed out and comparitive series analyzed. In certain instances recurrent superficial skin nodules disappear completely There is little doubt that the smaller and more cellular growths respond quickly to radiation, but at the pres ent time proper surgery should be the treatment of choice in all oper able tumors of the breast. It is probable that radiation by the deep method for very long periods of time may delay the progress of the disease even when cure cannot be expected. The great variability in the natural history of the disease, however, renders this somewhat doubt ful When the disease is widespread with mediastinal, plenral, or pul monary involvement, or there is general caremomatosis, little can be ex pected from radiation

Abdominal Conditions - Certum abdominal tumors become smaller and may disappear on deep and intense radiation. In this class are large retroperatoneal surcomata, lumphomata and cases of splenomegaly Cases are reported in which sarcomata and hypernephromata have disappeared. knowthals of the cases are reported by very few, so that it is difficult to of they the degree and duration of the clinical improvement. In cancer proved a castro-interic system there is little evidence that ridiation has there has of any value. In the majority of such cases, treated personally it was north been a marked relief of pun and patients have even felt that to seem to the to go considerable distances for treatment in order to seems even temple to go considerable distances for treatment a few which durnition wars relief, usually only a few days or occasionally a few wicks durnition. It is, of course, quite probable that a certain degree of relief matter. gree of relief in these cases of malignant disease was due to the encourage ing fact that something was been sing done.

In a case of Allie of the case of the cas

In a case of adenocarcinoma Fronof the uterus with transplantation of the growth in the fat of the abdomin al wall, the large and inoperable mass entirely disappeared under two serie es of intensive radiation by radium After the first series the growth becomes much smaller and the second series was given shortly afterward, instant tad of allowing the usual four to six weeks interval, at the entreaty of the phase titent and her husband, although t was carefully explained to them that been termined for the skin would probably result. The latter occurred and it was a many had not recurred two versul burns healed. However, the termined was a had not recurred two versul. ulb burns healed Howe er, the tumor mass the dlent This case is an externand the patient's general health was execution o had not recurred two veirs

Certain cases of ascites from abdominal caronable or have been reported prelieved, but the variability of such cases [In casurally leves the actual like doubted]. relieved, but the variability of such cases nati reat n

A case of syphilis of the liver, with extreme!

which very frequent aspiration was neces ary, was treated personally by radium applications to the abdomen and the ascates recurred less and less frequently

It is probable that surgers combined with executed application of radia tion would greatly improve the present results in abdominal disease

Pelvic Diseases—I ectum — In a neuman of the rectum particularly adocaremona just above the splinkter Burnam reports that some cases are definitely curible and that no others, there is marked improvement under radium treatment, deep carcinomatous where of the rectum are not improved, although polypi unva do well. Critani of the squamous-cell carcinomata about the amus are much improved by radiation and others are less so. Perliminars colosition is advisable.

Bladder—Chrome uleers of the bidder may be improved by radia tion and also papillomata althou, him the letter ful quration is probably preferable. The pipillars type of carmonia is more favorable than the squamous cell variety. In applying radium it is better to open the bladder

and thus make more exact application for the requisite time

Prostate—It is reported that hap ritrophic of the prostate is improved in certain instances. Numerous cases have been reported. In our experience exactions of the prostate has not been cured. Larger doses and better methods will doubtle a secure more favorable results. Bugbee, claims better results from exposure of the prostate supraphically destruction of the cancer by ridining medics introduced through the prostate from above close to and parallel with the urethra and from needles untroduced into the prostate through the princeum and late surface, ridium applications accurately made white drainegs is maintained. Application to this prostate through the rectum is also advisable. The term—ture should not be u of un these cases.

Testicle—Limbryomata of the testicle particularly the cellular so called round-cell around may wild to reduction even when the regional plands are involved. We now have under observation in apparently perfect health a young adult in whom there is no sign of resurrance even though the inguinal glands were involved when the testicle was removed under relation started two very seen.

A great deal has been written particularly within the last few years concerning the value of rulimin treatment in ginecology. Indeed, the subject has been taken up by some of the foremet generologists in this country and more especially in Furupe. What ten years ago some of the European generologist is made a tounding, statements regarding the beneficial effects of radium in cineer of the items but wine of these same men later mide the most dispuriging remarks concerning, its use Ladiumi therapy indoubtedly laws large field of a chilares in geneology. The valuable results obtained depend in a large measure upon the in trusty of the relation and this accuracy of the application to the lesson

to be treated. The resistance of the pathological tissue, the leasth of ix posures and the intervals between them is determined by the chineal inde-

ment of the operator

I ulta -Mo t of the patients with exemping of the vulva base post operative recurrences and the majority have metastases. In such cases radium therapy has proved of little value, except in cleaning the lead condition and in rules me hemorrhage. Printing and leutoplake may be creatly relieved

I agina — The fungating type of cancer of the vaging may yield quite readily to reduction. In the indurated type results are not good and sufficient radiation is and to cause a formation of fistule. They are also int to occur in the natural course of the discuse whether primary of seonders. One cale was treated personally with radium in which an in sastro indurated recurrent carcinoma disappeared and the large recor vagual fistula resulting was successfully closed by a gynecologist and warmed healed

Leukorrhea may be relieved by radiation although the possibility of at least temporary amenorrhes hould be remembered. Polym of the

laging are usually cured by radium theraps

Dierus — In carcinous of the host such excellent results are obtained by proper surgical measures that only for exceptional recoms should radium therapy be employed, except in inoperable cases of caremoma of the cervix however, only a very small percentage are distructive operable when first seen by a competent physician, it is in this group of cases, therefore, that radium therapy finds its greate t negative. Although much has been written concerning radium theraps in eneer

of the nterus, not a sufficient number of cases have been studied and carefully followed up to recommend any treatment except an operation, in cases which are operable, nules the general condition of the patient contra indicates or the family are unwilling to con cut to an operation In addition to these moperable cases radium therapy as used in post operative recurrences and after operation in prophylaxis of recurrence In the inoperable and recurrent ca es of circuloma of the certix the results are in a large measure pillative One unfamiliar with the course of the discuss as modified by radium treatment would be inclined to think, after a few scries of treatments, that the condition was cared The term 'healed," applied by some observers, we believe is misleading for the reason that under the first few series of radium treatments fingation carcinomata of the certix mix disappear, and the ulceration in the ul erst ing indurated type may become less and less and finally apparently lesl, and the induration about it may be markedly le sened. Such a condition might be called healed and lead to the natural supposition that the process was cared This, however, is not usually the case Sooner or liter, the disease extends, even if it does not recur locally, and the pitient suc-

cumbs to it Certain cases however, distinctly inoperable at the out set even with fivation of the uterus and metastases in the vaginal wall man, after the primary improvement and local healing be successfully operated upon. Thus distinctly imperable cases may exceptionally be converted into operable ones. Sometimes growths which respond promptly to the first series of radiation later become resistant to all radiation treat ment. In certain instances it is desirable to combine local vaginal treat ment with applications of radium to the abdominal wall and back. in order to increase the cross fire effect. At least temporary relief from hemorrhage, discharge, and pain and healing of ulceration are common in carrinomata of the uterus treated by radiations. Some cases may remain well for months or even years

After radiation, a small number of cases of carcinoms of the interus develop so-called totic symptoms which include hesdache vointing pros tration, and rise in temperature. There may also be such local symptoms as pain in the back and legs tenerims or frequency of micturition. These

symptoms disappear in a few data

Schauta, in his series of thes in 1913, used intenso radiation and many of the patients developed extensive local necrosis. The tendence of the majority of those using ridium at the present time is to use a dose of about 100 milligrams of radium element 2 millimeters of lead or 1 to 11/ millimeters of brass, or its courshipt in silver or platinum for filtration and a duration of exposure of twelve hours every few days for five to eight treatments At intervals of six weeks the series is re peated Such cases rarely develop fistally or extensive necrosis and there is at least temporary local and general improvement. Kelly and Burnam have reported that of 199 moperable cases treated -3 were elimically cured 108 markedly improved and 37 not improved Schmitz u ed 50 milligrams of radium in cases of exremoma of the interns for ten to twelve and occasionally twenty four hours and repeated this after from seventy two to ninety-six hours. After having given a dosage of from 3 000 to 4,000 milligram hours he gave the treatment weekly, until he had given a total dosage of from 5 000 to 10 000 milligram hours Bummi found that all cancer cells were destroyed within a distance of 4 centimeters but that they were viable beyond this Cheron and Rubens Duval made a postmortem examination of a patient dying of an intercurrent disease fifteen months after the clinical cure of curunoma of the uterus by radium. In a complete postmortem and careful serial histological examination they were unable to find cancer cells

The scirrhous, inverting type of careinoma of the uterus cems usually less improved than the more fungous everting type which tends to in tolve the valual walls During and between treatment it is important that the local condition be kept as clean as po sible by a mild clean ing solution of boric acid bicarbonate of suda or pota sium permanennate

A few cases of choice-entheliona have been reported treated by ridu These cases, in most instances, metastasize to the lungs early Owing to the few ex ex of surcome of the nterns trusted no conclusions can

Of the benian tumors of the uterus fibromata and fibromamata have been extensively treated in this country and abroad. Although there is much skenticism regarding the results, a large number of cases have now been reported in which the size of the growths has diminished or they have entirely disappeared. It is admitted that certain small percentages seem to be uninfluenced In the majority of cises, however, not only does the tumor duminish in size but the symptoms of menorthagia or metrorrhagia ccase Both intravagnal and surface applications are made Amenorrhal is caused in the majority of cases. Some of the foreign clinics report 80 per cent of cares in cases of myomata treated by radium Acily has used 30 to 724 milligrams of radium inserted into the uterus and has, in some ei es given an idditional massive treatment through the abdominal walls. The treatment requires confine ment of the patient to the bed for not over one or two days

Menorrhagia and Metrorrhagia -These conditions, impassociated with the presence of tumor, due to various myopathies or neumpathies or to disturbed ovarian function are, in the large minjority of cases, very greatly benefited or cured Burum uses 300 milligrams of ridium applied within the uterus for three hours. This usually causes complete amenor rhea In young women the durition of application is shortened, 500 mills gram hours or less, and in such instinces menstruction may return

L J Stacy reports the results of radium treatment in 600 cases of menorrhagia and concludes that, while surgery is still the method of choice for young women who have definite fibroids cansing menorrhania and those with a suspected careinoma of the fundus, Roent, eu rays and radium are successful therapeutic agents in carefully selected cases and in women over thirty five In the treatment of menorrhagia in patients more than thirty ive years old, who have a fibrous aterus or a small myoma, and in younger princits in whom involnectomy or hysterotomy is not indicated or in whom curettige has not controlled the bleeding radium is a very satisfactory therapeutic accut

Radium is contra indicated in pelvie inflummatory di case or where there is a history of pelvie pun, since a quiescent infection may be

lighted up

A smill dove is given women under thirty five in order to control bleeding but not to cause constion of menous. It is better to repeat the treatment a second time than to cause the meastrail flow to cease entirely by too large an initial dose. The average dose used was 293 milligrum liours for patients under thirty five and about 700 milligram hours for older women

Artificial Menopause—Radium max be u ed successfully in cases when times seem desirable to produce an artificial menopau e. A routine curettage with histological expansion of the curettings to exclude new growth should precede the application of redium in most cases of uterine bleeding even in young women.

# Shumars Ridium has been proved to be a physical agent of innique character

It has been shown to have a destructive action up at certain kind of tumor cells However, the cherished hapes and the fantastic claims that it would cure malamant disease and ultimately replace surgery base not been realized. In speaking of cures by radium we must be very guarded and must consider the type of growth with which we are dealing. Definite and permanent cures of superficial cancer of the skin of the basel called type are obtained in the majority of ca exproperly treated by radium. Lapidly growing cellular types of milimant dies coften how astounding tem porary regression for varying periods. Malignuit tumors which are les cellular and the e which meta tastre early full as a rule to respond so well even temporarily. There is however exceptions to this rule. Marked clinical improvement with disappearance of all visible or palpable. signs of the disease does not necessarily me in a permanent cure. Careful histological study of these apparently normal tissues will show in the vast majority of cases that not all the tumor cells have been destroyed but that scattered groups he came heal in fibrous to sue and surrounded perhips, by lymphocytes—a birrier by no meins impervious to subsequent growth and metastrais. With complete chinical cure of the primary tumor there may still exist exten me remonal or remote involvement. A cure can be obtained only when the list sunk abnormal cell has been destroyed Up to the pre ent time this has been impossible in the great majorits of cases

The pulliture effect of ridium in relieving hemorrhage, pain, dis charge foul odor and in proloning life temporarily in many instances is undisputed.

There is an occasional case of proved malagarant there where the patient remains curred for ten to fafteen verus and perhaps permanently. The malagarant prominence pixen to these cases which are exceptions rither than the rule has given rise to the extraordinary and functiful claims which have been model 1s so me for the curriture power of radians.

Radium as a medicural agent taken internally leas perhaps some value but as yet there is not sufficient carefully collected data to substantiate the claums made for it.

It is hoped that in the future the securses of the diagnous of all cases treated by radium may be carefully corroborated by by tobale (xamin)

A few cases of chorro-emthelioma have been reported treated by radia tion These cases, in most instances, metastasize to the lines early Outnote the few cases of sarcoma of the uterus treated no conclusions can be drawn

Of the benian tumor, of the ulerus fibromata and fibromamata have been extensively treated in this country and abroad. Although there is much skepticism regarding the results a large number of cases have now been reported in which the size of the growths has diminished or they have entirely disappeared. It is admitted that certain small percentages come to be uninfluenced. In the majority of cases, however, not only does the tumor diminish in size but the symptoms of menorrhans or metrorrhagia cease Both nutravagual and surface applications are made Amenorrhea is caused in the majority of cases. Some of the foreign clinics report 50 per cent of cures in cases of mounts treated by radium hells has used 30 to 724 multigrams of radium inserted into the uterus and has in some eacs, given an additional massive treatment through the abdominal walls. The treatment requires confinement of the patient to the bed for not over one or two days

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Radium is contra indicated in pelvic inflammatory disease or where there is a history of pelvic pun, since a quiescent infection may be

lighted up A small dose is given women under thirty five in order to control bleeding but not to cause co sation of menes. It is better to repeat the treatment a second time than to curse the menstral flow to cease entirely by too large an initial dose. The average dose used was 200 mill grim hours for putients under thirty five and about 700 milligrum hours for older women

Artificial Menopause —P-duim non be used successfulls in cases when it may seem desirable to produce an artificial misopause. A routine curitage with histological examination of the currettings to exclude new growth should precede the application of ridium in most cases of interine bleeding even in voing, women.

# Senvary

Radium has been proved to be a playment agent of unique character It has been shown to have a destructive action upon certain kinds of turner cells. However, the charished hope and the funtastic claims that it would cure milimant disease and ultimately replace surgery have not been realized. In speaking of cares by radium we must be very guarded and must consider the type of growth with which we are dealing. Definite and permanent cures of superficial cancer of the skin of the basal-celled type are obtained in the majority of ca exproperly treated by radium. Rapidly growing cellular types of malian int di case often show astounding tem porary regression for varying periods. Malignant tumors which are less cellular and the e which metastasize early fail as a rule to respond so well, even temporarily. There are however exceptions to this rule Marked clinical improvement with disappearance of all visible or palpable signs of the disease, does not nece sarily mean a permanent cure. Care ful histological study of the o apparently normal ti sues will show in the vast minority of cases that not all the tumor cells have been destroyed but that scattered groups he ennie had an abrous tissue and surre unded perhaps by lymphocytes-1 burrier by no means impervious to sub equent growth and metastisis With complete clinical cure of the primary tumnr there may still exist extensive regional or remote involvement. A cure can be obtained only when the last single abnormal cell has been destroyed Up to the present time this has been impossible in the great majority of cases.

The pullrative effect of radium in relievin, hemorrhage print dis charge, foul odor, and in prolonging life temporarily in many instances is undisputed.

There is an occasional case of proved malaginal disease where the patient remains curred for ten to inflict a veries and perhaps perminently. The undin prominents, piven to these evers which are exceptions rather than the rule has given rise, to the extriordinary and fameful claims which have been made by some for the curative power of ruleum

I adom as a medicinal agent taken internally has parhaps some value, but as yet there is not sufficient carefully collected data to substitutivate the claums made for it.

It is hoped that in the future the accuracy of the diagnosis of all cales treated by radium may be can fully corroborated by histolyne examina

tion of tissue removed for this purpose, and that such cases will be fol lowed for end results, so that we may have an ever increasing volume of accurate statistics upon which to base our judgment as to the ultimate value of radium as a therapeutic agent

value of radium as a therapeutic agent.

Improvement in the results obtained may possibly come in the future by the more accurate methods of application of radium to the pathologically in question, so that fewer escape its destructive action than is at present the case. Careful study of the unusual cases which are apparent cures for long periods may shed light on the optimum method of application and dosage.

#### CHAPTER XIV

#### X RAY THERAFY

## JOHN REMER

Introductory —The discovery of the X ray marked the beginning of a new era in medicine from a therapeutic as well as a discussite standpoint

The physical proporties of these rays, by which they can penetrate matter opaque to light, and their effect on the photographic plate, af forded a means of visualizing conditions within the body which previous to this time could be diagnosed only by their symptoms and chinical signs. Their biological action provided a therapeutic agent to combat successfully many diseases and conditions which had previously responded unsatis factorily, if at all to include ano and other forms of treatment

Although numerous other workers had been experimenting along the same line, it was Pentigen who in November, 1895, gare the results of his discovery to the world. It was but a few months after Rotingen a discovery that other exp. rimenters called attention to the biological action manely, that by experier to the ray erithema or dermatitis was produced. This led to the hypothesis that in the discovery of the X ray an agent of therapentic value had been found. Its first twe was directed to the treat ment of the more cresistant and of the incurable. Although the same conditions such as lupus entitlehours, and hypertrebass.

As is usually the case when a new therepositie agent is given to the profession, the X-ray was considered a panasca. During the next few tears there was kery edge condition that was not subjected to this form of therapy. The natural result of this widespread indiscriminate and frequently unitedligant use of so during rous an agent was that the literature was soon filled with reports of hums varying in severity from indi exculation to a necross of even the deeper tissues. Then followed a period in which the nise of the ray in therapeutics was looked upon with great disfavor by the profession at large only a five of the more carnest and persevering workers continuing its use. As a result of the painstaking research and experimental work of these, few certain being principles governing. X-ray therapy were established. The most important of these areas.

tion of tissue removed for this purpose, and that such cases will be followed for end results, so that we may have an ever increasing volume of accurate statistics upon which to base our judgment as to the ultimate value of radium as a therapeutic agent

Improvement in the results obtained may possibly come in the future by the more accurate methods of application of radium to the pathologic cells in question, so that fewer escape its destructive action than is at present the case. Careful study of the unusual cases which are appured cures for long periods may shed light on the optimism method of application and desage. termind, and within the tube are placed the anode or 'target,' which is usually mide of tingsten and the cathode which is usually a cup-shaped metal die so arranged as to foems the strein of electrons on the center of the target. There are in u c to-day two types of tubes first, those depending for the electrons on a small amount of gas left within them, called gas tubes second the e which supply electrons from a heated wire or hlament placed at the cathode and known as the hot cathode or more familiarly, Coolidge tubes—in honor of their inventor, Dr. W. D. Coolidge.

Gas Tubes—Gas tubes continue a small amount of air (or other gas) from which in its rareford etitle electrons are readily liberated. The current entering at the eathode directs these electrons against the target (at a speed equal to one-third to one half the velocity of light) where they are aburply stopped and at which point the X-rays are generated Continued use dumin hes the supply of electrons and causes tho tube to become hard that is it requires greater voltage to operate. Therefore a device mult be supplied that will permit more gas to be admitted as required. To accomplish this a valve containing certain chemicals (in all) must or absolved by a lock of the tube. When a small discharge current is passed through this valve gas will be liberated into the tube. This procedure is called softening? The tendency of the gas tube to harden makes impracticable its use in therapenties where a constitut and uniform tible resistant must be muntained since a change in this factor alters the character and unount of the radiation produced and, also any varietion makes it impossible to estimate accurately the amount of radiation generated

Coolinge Tube—The general contriction of this tabe is simular to that of the gas tabe. But the air is exhausted to such a point that the great est possible vacuum is obtained. But the eithede is placed a coil of tun, sten were connected to a low voltage electric current (supplied by a storage battery or a stop-lown transformer). When the circuit is closed the coil (or inhunent) becomes heated and liberates electrons. The hotter the altiment the offer the tible By means of a current countrol the tem perature of the filament can be regulated at will so that the tube may be munitained at any giv in degree of hardness for an indefinite length of time. It was the advict of this tiple of time that overcome one of the greatest difficulties confronting the radiother speculist, and since its invention the prop. was of radiotheraps has been marked.

Transformer—In the errly days of the \times ray, the electrical current was supplied by status machines. These were soon replaced by various tyres of indiaction code, which although more satisfactor have in more recent times been supplanted almost entirely by the 'interrupterless transformer. This machine consists of a primary winding around a soft iron core and an extensive secondary winding, in which the high tension

1 That the beam of ray as generated by the X ray tube is not homose neous, but is composed of radiant energy of varying wavelengths.

2 That these varying wave-lengths have a different biological action, the longer ones having little penetratin, power and being absorbed by the skin, while those of shorter length penetrate to the decipar tissues

3 That on the depth of the lesion depends the type of ray which is

most effective

- 4 That certain substances, such as aluminum, glass, copper or 21st, when interposed in the path of the ray, filter out or eliminate the soft rays, that 19, those of long wavelength. This makes possible the utilization of the type of ray best suited to the eye under transment.
  - 5 That the skin will tolerate only a limited amount of radiation

With the establishment of these principles, there came a reaction, and the value of A ray as a therapeutic upon was established

#### PHYSICS

X ray is a form of radiant energy which is produced when a stream of electrons, set in motion in a vacuum at a high rate of speed, are suddenly stopped. It is similar to light, and travels with the same velocity

À rays move in all directions from the point of source, until absorbed by matter. The expacity of matter for absorbing these rays is in direct proportion to its stonic weight. The beam of A rays is heterogeneous, being composed of rays of various wivelengths. The alpha rays are the longest and are spoken of as "soft rays", the 'hard rays" or those of softest length, approach very nearly the gamma rays of ridium. X rays are invisible, and cun be detected only by their action first on the photo graphic plate, second, on certain cristals, third on tissue (biological action), fourth on the ionization chamber, and fifth, by their place in the spectrum.

In order to produce A rays it is necessary to have

1 A vacuum

2 A source or supply of free electrons

3 A heavy metal 'target," placed in the path of the stream of electrons

4 A means of setting the electrons in motion it a high rate of speed

The first three are found in the X ray tube while the fourth is supplied by some form of electrical apparatus, that known as the 'X ray transformer' being the most efficient

X ray Tube — The \ ray tube is a glass bulb from which all or nearly all, of the air has been pumped. At either end is an electrical

thousaudth of an ampere has change in the milliamperage changes the quantity of radiation. The higher the milliamperage, the less time required to produce a given amount of rix with a given spark gap. In radiother-pix two to seven milliamperas are assult employed a greater amount cusing the tuble to heat to x-rapidly for practical therapoute pur pass. Furthermore, longer irradiation is frequently advantageous on account of the greater amount of secondary radiation produced.

Distance—Distance represents the number of inches or centimeters from the target of the tube to the nearest surface of the body. This

factor is varied according to the preference of the operator

Time —This factor is the actual time that the Vrays are being directed to the surface under treatment

Filter—In order to climinate the soft rais, various substances are interposed between the skin and the target of the tube. The filter is placed in a slide arranged in the tube-stand for that purpose. The substances generally complosed are glass aluminum brass copper and zime. Sole leather is used by some as are paper channels shin and slik but these are of questionable value. The greater amount of filtration used, the less total radiation reaches the patient but as the soft rays are the measure eliminated at its possible by proper filtration to utilize only the most penetrating rays thus delivering a more homogeneous ray

Another factor which is of importance in considering the amount of radiation delivered to the lision is the size and number of areas treated Depending somewhat on the choice of the operator but more on the locution and character of the lesion this factor varies greatly. In superficial therapy its necessary to expose an area only slightly larger than the lesion itself. In deep therapy however it is frequently necessary to expose the antenior, posterior and lateral surfaces of the body, in order to deliver to the lesion a sufficient quantity of ray without injury to the skin. Again by exposing small areas and carefully shielding the surrounding skin it is possible without harm to the patient to give much larger quantities of ray to a given portion of the body than if only one area were used. Furthermore, the larger the area exposed the greater the amount of secondary radiation produced.

No absolute or fixed rule can be given governing the conduct or treat ment of any particular condition and in outlining the treatment of various diseases the author is merely indicating the method found beneficial in the treatment of the imajority of ease. It must be remembered however that every case is an individual one and that the success of the radio-therapeutist depends above all on his ability to recognize the special requirements of each patient and his insumity in meeting them. To say that accurate dispensors is of the greatest immortance and that

X ray treatment should never be undertaken until it has been established may seem an affront to the profession However as results depend largely

or secondary current is induced. The current supplied to the primary is usually 110 or 220 volts, and must be alternating current. The current obtained from the secondary is from 10,000 to 200,000 volts, and is also alternating In order to operate the X ray tube direct current is required. and a rectifier is placed in the secondary circuit which makes it possible

to deliver the proper type of current to the tube 1

There are certain electrical and physical factors which govern the quality and quantity of X ray, and by which the amount of radiation applied may be estimated. In considering the amount of exposure, these factors are most important, and it must be borne in mind that a change in any one of them alters the character or amount, or both, of the radia tion applied The important factors are spark gap (voltage), milh amperige, distance, time, and filter

Spark Gap (the Unit of Voltage) -The unit of measurement of difference in potential between the positive and negative side of an electrical apparatus is the volt, and is usually measured by a voltmeter. Due to various mechanical and electrical difficulties, it has been, in the past, advisable to use an approximate method of measuring the high tension voltage instead of a meter | Electrical currents always follow the path of least resistance. The X ray tube offers resistance which varies in direct proportion to its hardness. If a wire or metal rod is so placed that it can be extended from one side of the secondary line toward the other, a point will be reached at which the current will encounter less resistance by jumping the gap between this rod and the other side of the circuit than in passing through the tube. This space is called the spark gap (S G) and has been the commonly used method of expressing voltage in computing the amount of X ray administered

A one-inch gap represents, approximately, 20,000 volts, and each ad ditional inch represents 10,000 volts so that a nine-inch spark gap is considered equivalent to 100,000 volts. In the latest type of machine (the 200,000 volt) there is a tendency to speak in terms of volts rather than spark gap Also, in these machines the measure of the spark gap is

between spheres instead of points

Any change in distance that the current will jump represents a change in voltage hence a change in the quality of radiation. The longer the gap, the more penetrating the ray In radiotherapy a six to fourteen inch spark man is employed

Ampere -The ampere is the unit of electrical current and represents the amount of electricity passing a given point in a certain length of time In roentgenology the amount of current used in the secondary line is so small that the measurement is the milli-impere, and represents one

Certain types of tubes can be operated on alternating current and the modern portable or bedside X ray outfit is thus made possible. In treatment however this type of tube and machine is impracticable

Some investinators believe that minute exposures have a stimulating action but the author does not igner with this contention believing that the action of the ray is always inhibitors. It is true, especially in neo plasms, that manifectual radiation will frequently be followed by an increa ed activity of the timon but this is probably due to an inhibition of the surroundin normal tissue and interference with the normal blood and liviph supply to the part instead of the autimulation of the growth. The same result will be produced by too prolonged radiation.

The re ponse of tissue to radiation varies according to the type of cells of which it is compo (d \emid cells are more resistant than patho logical, and the nearer the cell approaches the embryonic type the greater and more complete the effect (onversely the more clo cly the pathologic cal approaches the normal the greater its resistance. But this resistance is always below that of the normal Ewing states that while normal lymphoid tissue is very resistant to the action of the ray, the same type, when puthological, is quite easily destroyed by it. It is due to this fact that it is possible to use the X tay therepeutically, for when the ray is applied to a pathological area normal to sue is necessarily exposed to its action and were all rells equally affected it would not be possible to destroy the discass d tis ne without at the same time destroying normal structure Obviously it is the area of the skin nearest the target that receives the greatest amount of radiation hence the limit of ray that can be applied must be no greater than the slan will bear without serious mjury

The second, and equally important factor in tissue response is its ability to recover from inhibitor. This recovery is in inverse proportion to the degree to which it is affected the tissue most difficult to affect recovering most ripully and mist unplied. Since the publishing and color recovering most ripully and his completely thin the normal it is possible to administer a second exposure, as soon as the hormal structures have recovered and while the principles and retill inhibitor. This second reduction still further inhibits the lesson without injury to the normal trainer in the preprint exposure it may be possible to destroy the lesson.

completely

Thus it can be readily understood that cases selected for \ ray treat ment must be ho em which there is pathological tissue present and this path logical tissue must be simple inflammatory chronic influmnatory, granuloma or morphistic that it must be possible to destroy the tissue without earning scream unjury it normal structures. In fibrous lessons, where only connective tissue is present no brack that lib denied

Althou, hall tis use will return to their normal activity within a definite time after lein subjected to the action of the X-ray their resistance remains lowered for a much longer period. Consequently if treatments are continued for too long a time without suitable intervals of

on proper technic, and since this technic wires so widely, there is construct danger cither of affording no relief or of actually doing larm, unless a correct diagnosis is catalylated. This applies not only to superficial therapy, in which various knows my so closely resemble each other as to be indistinguishable to the untruned observer, but to the entire field of deep therapy as well.

In the development of the 200,000 volt technic, every effort is being made to standardize all factors, and extensive experimental work has been and is being conducted by radiotherapeutists in collaboration with physicists and biologists. Absorption of X ray by tissue has been carefully studied, and curves plotted to show the exact amount absorbed by each successive centimeter. Investigations are being conducted to estimate the amount of secondary radiation produced. In this work the ionization chamber is employed to measure the amount of radiation and in every way offerts are heing made to advance the technic along thoroughly ser entific and absolute lines However, the fact must not be overlooked that medicine in all its branches is an art, and not a science, that biological reaction cannot be accurately measured, nor can the effect of an agent on living, cellular life be considered the same as its effect on inorganic or non living material. So that, while this work is in the right direction and of mestimable value, the individuality of each case must govern its treatment

In the use of the newer method there is considerable viriation in technic. Tilters employed vary from ½, to 1 millimeter of copper plass 1 millimeter of aluminum. The distance ranges from 40 to 100 cmu meters, and the area of exposure is from 10 to 25 centimeters square.

By securitely locating the tumor, eirefully mer uring the body and from the charts of absorption curves estimating the number of portals and amount of radiation necessary to each portal, the growth will recent the required percentage of an erythemi dose, and at no point will the skin receive a greater amount than is compatible with safety

# GENERAL CONSIDERATIONS OF X RAY THERAPY

Before beginning a discussion of the merits and limitations and the virious methods of administering X ray for theoryeutic purposes, it is desirable that there should be a clear conception of its tetton. In speaking of the various means of detecting the ray, the biological action and its effect on living cells was de eribed. This effect is inhibitors and varies in degree in direct proportion to the amount of radiation applied. If sufficient is administered, complete destruction or necrosis of the cell follows.

Some investigators believe that minute exposures have a stimulating action but the author does not igne with this contention, believing that the action of the ray is always inhibitor. It is true especially in nee plasms, that insufficient ridiation will frequently be followed by an increased activity of the timen but this is probably due to an inhibition of the surrounding normal tissue and interference with the normal blood and lymph supply to the part instead of to a stimulation of the growth. The sum is rule will be produced by too prolonged reliation.

The reponse of tissue to radiation varies according to the type of cells of which it is composed Norm il cells are more resistant than patho logical and the nearer the cell approaches the embryonic type the greater and more complete the effect. Conversely the more closely the pathologic cal approaches the normal the greater its resistance. But this resistance is always below that of the normal Ewin, states that while normal lymphoid tissue is very resistant to the action of the ray the same type when pathological is quite easily destroyed by it. It is due to this fact that it is possible to u c the X iav the repetitically for when the ray is applied to a pathologial area normal tissue is necessarily exposed to its action and were all cells countly affected it would not be possible to destroy the discased tissue without at the same time destroying normal structure. Obviously it is the area of the skin nearest the target that receives the areatest amount of radiation hence the limit of ray that can be applied mu t be no greater than the skin will bear without serious mury

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completely

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Although all tissues will return to their normal ictivity within a definite time after being subjected to the action of the X-ray their resistance remains lowered for a much longer period. Consequently if treatments are continued for too lone a time without suitable intervals of

rest, atrophy of the shin and subcutaneous tissue will result, lithough at no time has there been sufficient radiation administered to cause even a mild erythema. Some tissues, most noticeably carcinoma, evem to acquire a tolerance for X ray. In cases of cancer it has frequently been noted that, although at first satisfactory progress was made, later the neoplasm increased in size, and the condition of the patient became steadily worse, even though the same or even a greater amount of radiation was administered. To this fact is due the present-day effort of therapeutist, especially those using the more recent high power machines, to administer the full, so-called, careinoma or sarcomy lethal dose at a single treatment

### EFFECT OF X RAY THERAPY ON TISSUES

Skin —As mentioned above the effect of the X rays on the skin is the guide to the amount of radiation that can safely be administered. If the amount of radiation is increased beyond safe limits there is produced (1) crythema, (2) vesiculation and depilation, and (3) ulcention and necrosis. Complete and permanent alopecia may result, and the functions of the glunds may be permanently inhibited. This subject will be treated at greater length in a subsequent paragraph.

Circulatory System—Blood—Within twent's four hours after radius there is an increase in the white blood count, due entirely to new polymorphonuclear elements. The Iraphoeutes are decrea of resulting in a leukoevtosis, together with a lymphopenia. The increase in the polymorphonuclear cells is prohibly caused by destruction of the lymphocytes, which calls upon the body for increased phagoevtic action. This condition persists only a short time, perhaps only a few hours, and is succeeded by a true leukopenia. This reaction, to a varying degree, always follows the administration of X ray, but unless the blood forming organs are radiated, the effect will be very transitory. Hence, in order to obtain beneficial results in the leukemias, the long bones, the spleen, and lymphatic glands must be exposed.

The effect on the red cells is slight, and it is only after massive administration that the presence of degenerated, or nucleated, forms is noted. Some authors consider this effect of great importance at tributing to it a peculiar evelexia which has been observed after prolonged.

radiation

The theory has been advanced and some experimental work has been to prove, that X ray causes an increase in the antibodies of the blood Clinically it is well demonstrated that results are obtained in parts of the body distant from those radiated. In Hodghin's disease, frequently only the trunk is radiated, regardless of the position of the glands involved, and yet a diminution or disappearance of all affected glands is obtained.

Again, in leukemia blood taken from a patient who had received radia tion was injected into a second patient suffering from the same disease. but who had not been so treated The white blood count of the latter was reduced When this same experiment was tried, using the blood of a non radiated patient no such result was obtained. It is believed by some workers that this antibody reaction is an important factor in careinomatous conditions, and that the beneficial results are due to it. as well as to the destructive action of the ray on the neonlasm congulation time of the blood is miterally shortened

After a very massive exposure especially about the head and neck, an edema in the area exposed is frequently observed. This is variously accounted for some workers contending that it is due to vasodilatation accounted for some workers contending that a reality of vasounination with consequent venous stass others holding that a proliferation of the lymphatic endothelium is produced which causes a lymph strais. The latter view seems to be the correct one, and is of importance in the preoperative radiation of malignancy

Eyes -The widespread belief that the eye is especially sensitive to the X ray seems to be without chinical foundation. Although it is true that conjunctivitie superhead keratitie units retinitie and even optic atrophy have been experimentally produced in small animals it was only after radiation had been carried far beyond the amount tolerated by the skin. In actual practice it has been found that the vision is in no way impaired when the eyes are unprotected during treatment of lesions about the face lupus epithelioms, etc. As a precautionary measure most workers when exposing known of the face cover the eyes with a lead shield, and while this is probably unnecessary the medicolegal aspect must ever be borne in mind and operators will do well to employ all possible precautions

Kidneys -Normal kidney tissue is not affected by \ ray admini tered in therapeutic amounts. Nevertheless massive radiation of the body is sometimes followed by clinical and prinary evidence of acute nephritis This is probably the result not of the action on the kidneys but of the added strain placed upon them in consequence of the sudden liberation into the blood stream of toxic material from the disintegrated tissues which received radiation. In kidneys already pathological such a neph

ritis is more apt to occur and to prove more serious

Nervous System —Nerve tissue is not affected by rational exposures Tumors of the brain have been successfully radiated and no evidence of

impairment of brain function followed

Lungs -It has been observed that prolonged radiation over the thorax sometimes causes fibrotic changes in the lungs. Several cases have been reported in which pleural effusion followed the application of massive exposures with the 200 000 volt technic Otherwise there is apparently no effect. Both the effusion and the fibrosis disappear

Thyroid and Thymus -I he effect on the thyroid has been recognized, and the X ray used for treatment of toxic hyperthyroidism for many years Moderate amounts of the ray cause a decrease in the function, and if sufficient ray is administered myxedema will result. This effect is considered by many physicians to be a contra indication to the use of radiotherapy for lesions around the throat and neck. Such contention is not justified by the experience of ridiother incurists, who find that to influence hyperthyroidism the ray must be directed to the gland itself, and that prolonged series of reductions for cervical adensitis, and the procedures followed in treating hypertrophical tonsil, do not can a the slightest evidence of duminition of thirroid secretion

Larynx -Over radiation of the larvax may cause temporary or perma

nent aphonia

Spleen - This organ is especially scusitive. By animal experimenta tion it has been found to shrink rapidly after being exposed to the me It necrops, it was found to be shriveled and discolored, the cellular

elements destroyed, and the lymphocytic nuclei disintegrated

Gastro intestinal Tract-Salitary Glands -- I vposures to even a suberythema intensity of filtered radiation may be followed by dryness of the mouth and threat, which persists a day or two, due to an inhibition of the glandular activity If sufficient expositres are given, permanent loss of the retirity of these glands will result

Stomach -Cises of hyperseidits treated by X ray have hid the amount of acid reduced, and their symptoms relieved While no special investigative work on this subject has been recorded, it seems remonable to suppose that all glandular activity may be inhibited by the Aray, hence, not only the hydrochloric read glands, but all others as well, are

probably inhibited

Intestine - Martin and Rogers, in their investigations, found that massive exposures to X riy, particularly with the 200,000 volt machine, directed over the intestines, caused an endothelial necro is Havin, determined the quantity of radiation necessary to produce an erythema on a dog's skin, they exposed a loop of the animal's intestine (laid on the belly wall after laparotomy) to the direct action of the ray. Two groups of animals were radiated, the first receiving the erythema exposure, the second, twice that amount

At the end of three weeks the first group of animals showed no clinical evidence of any untoward effect of the ray An autopsy performed t this time showed that the exposed loop of intestine was shortened two thirds of its length, its lumen narrowed, its epithelium desquamated and all vills ab cut The loop was hyperenue, the mucost thickened, and the

muscularis vacuolated

Animals of the second group were clinically well on the fourteenth day, but refused food on the sixteenth. They then repully lost weight,

and on the ninetcenth day their condition was such that they had to be called. At autopsy the same condition was found as was observed in Fromp 1, but to a more advanced degree. Their conclusions in part are

- 1 The erythema dose for a dog's skin when applied directly to the intestine produces hypercinia marked contraction in all directions, and lestruction of the spithelial liming
- 2 The intestinal damage to day resulting from direct radiation, loss not always produce early death
- 3 Bloody diarrhea, inheration perforation and stenosis occurring in patients subjected to deep theraps for abdominal lesions may be due to direct intestinal injury
  - 4 Poentien cacheria is possibly due to the same canse

These experiments are of particular value at the present time since in the attempt to overcome carcinoma efforts are being made to deliver

a depth dose of 110 per cent of the erythema exposure

Reproductive Organs — The behef that sternization may follow the ica t exposure to X ray 1s so firmly fixed in the minds of many that it seems advisable to speak at some length on the subject in order that the widespread fear of the ray, on this account may be dissipated

It is true that both the testules and ovaries are sensitive to the rai and that, following sufficient exposure apperual or premature mesopausous will occur. The effect is mainly on the germanal crathelium which can be completely destroyed but only after relatively heavy radiation eer tainly not after a single fractional exposure, such as is received by p.rsons.

visiting an X ray laboratory at infrequent intervals

By animal experimentation at was found that one-third of an erythema exposure, directed to the testicles caused a disintegration of the sperma

torea and a diminution in their number

Complete sterilization risults only from massive doses the so-called castration dose with the 200 000 tolt technic being placed at about 40 per tent of the maximum amount tolerited by the skin. In the experience of the author it requires a subcritheina exposure filtered applied to each of seven ports of entry and repeated at four week intervals two to four times to produce a premature minopusse.

Before the boological effect of the ray was understood and protective precautions observed many radiologists or their technicians were being constantly exposed to the ray. It was found that after from one to five years, numerous operators developed aspermia. Tater nive tigation of tiese cases showed that this condition disappeared in about two vears if the work was abandoned or suitable protection used. The technical workers of some of the large experimental laboratories are now protected by a special lead and leather garment and atthough they are exposed to

excessive amounts of X radiation, they are not made sterile. Ample protection is afforded by the lead rubber upon in common use. There is no reason to fear causing sterility unless the testicles or overnes are to be exposed. Where exposures about the pelvis are to be made, suitable X ray protective material should be placed over the overnes or testicles or, if these organs must be exposed, the patient should be warned of the probable result be fore the treatment is undertaken

Steiger reports an interesting case treated for uterine fibroid. Profeed to 1907 the woman had had four children, there were no further pregameness until 1914, at which time she aborted at the tenth week. In 1914 she was found to have a fibroid, complicated by hyperthyroidism. The patient was treated for both of these conditions on June 7 and 21 July 3 and 10, and August 2. She menstruited July 19 and 28, three day each time. No further menstruition after September, 1917. Treat ment of the thyroid was continued until May, 1918. She became pregnat in September, 1919, and in the latter part of April, 1920, was delivered of a normal child.

Pregnancy—Although mulformations and monatrosities have been hatched from chickens' e.gs that have been exposed to radiation there are no cases in the literature which show any untoward effects following radiation during human gestation

Bacteria — It has been found by experimentation that the beta riv it the most destructive to microorganisms, which have been killed at a depth of 2 millimeters below the surface of gelatin midis. The amount of radiation required is so excessive that in hum, tessie no direct bacterical effect can be obtained by therapeutic amounts. It is nevertheless true that many skin lesions of recognized bacterial etiology respond favorably to radiation. Many theories have been advanced to account for this, such as increased phagocytic action of the blood-cells, production of bacterioly the enzymes, and one investigator was able to demonstrate an increased opsonic index after radiation. Whatever the explanation of this may be, the fact remains that areas radiated do tend to become free from beteria, as is well illustrated in the treatment of diphtheria-carriers, the cultures from whose throats become negative after one or two exposures.

#### RADIODERMATITIS

Following an X ray exposure there is, is his already been stated as inhibition of all tissues. If the amount has been small a return to normal will occur in a short time without any physical manifestations. If, however, the exposure has been of sufficient intensity, there will follow, in a period of from a few days to two weeks, an crythema or ridiodermattis. This must not be confused with the crithema which frequently appears.

in from one to twenty four hours following an exposure and disappears in from twenty four to forty eight honrs due, according to I fahler to electrostatic discharge, and can be prevented by grounding the lead foil protective

Radiodermatitis is of three degrees first second, and third

The first degree is characterized by an erythema which appears in from seven to fourteen days, and varies in intensity from a faint blush to a deep rid, reaching its maximum in about two weeks, and disappear in, in about four weeks. It is followed by mild pigmentation or tanning. which may last several weeks or months, gradually disappearing

If the exposure has been on a hairs part an alopecia will result which may be either temporary or permanent. This reaction is accompanied

by a slight burning or stringing sensation and itching

In second-dearee radiodermatitis the erythema is apt to appear some what earlier than in one of the first degree. It is characterized by crythema vesiculation exudation and excoriation, accompanied by a burning still ring sensation which may be severe and distressing. Second degree radiodermatitis usually requires several weeks or even two or three months to heal, depending on its several and the extent of the area bazlazar

In third-degree radioderm utitis it is difficult to draw a sharp line of demarcation between a severe second and a mild third. It is character used by all the symptoms of the second degree and in addition there is always an ulceration of the true skin. The erythema usually appears in three or four days and as a rule the earlier the appearance of the erythema the greater the severity of the radiodermatitis. Almost from its first appearance the erythema is a dusky or even purplish red, and usually there is an ulceration of the skin subcutaneous tissue and there may be an involvement of even the deep muscular tissue and fascia. It is accompanied to an evaggerited degree, by all the symptoms of second degree radiodermatitis, and in addition the pain is exceedingly severe

Sequelæ -The first degree results in tinning which will disappear as a rule within a few weeks or months following a single exposure If repeated erythemas are produced atrophy will result followed in six months to one year by telanguectasia and permanent alopecia if hairy portions are involved. It is an axiom to bear in mind. Never produce an erythema especially in an exposed part unless the condition warrants the possibility of sub-equent atrophy and trlingiectasia that is, in epithelioma lupus vulgaris etc. but never in acue tinea tonsurans etc.

The second degree results in atrophi alopecia telangicotasia, and later keratosis which may degenerate into epithelioma, which is always of the squamous or prickle-cell type

In the third degree while there may be healing after a period of a few months with resulting telanguectasia atrophy and keratosis, which excessive amounts of X ridiation, they are not made sterile. Ample protection is afforded by the lead rubber apron in common is. There is no reason to fear causing sterility unless the testicles or ovaries are to be exposed. Where exposures about the petris are to be made, until X ray protective material should be placed over the ovaries or testicles or, if these organs must be exposed, the pattern should be warned of the probable result before the treatment is undertaken.

Sterger reports an interesting case treated for uterine fibroid. Prict to 1907 the woman had had four children, there were no further preparence until 1914, at which time she aborted at the teuth week. In 1911, she was found to have a fibroid, complicated by hyperthyroidism. The putient was treated for both of these conditions on June 7 and 21, July 10 and 28, three days each time. No further menstruated July 10 and 28, three days each time. No further menstruation after September, 1917. Treat ment of the thyroid was continued until May, 1918. She became pregnat in September, 1919, and in the latter part of April, 1920, was delivered of a normal child.

Pregnancy—Although malformations and monstrosities have been hatched from chickens' eggs that have been exposed to radiation there are no cases in the literature which show any untoward effects following

radiation during human gestation

Bacteria — It has been found by experimentation that the beta ray is the most destructive to microorganisms, which have been killed at a dight of 2 millimeters below the surface of golutin media. The amount of radiation required is so excessive that in living tissue no direct bacterical effect can be obtained by their pentic amounts. It is invertible sature that many skin lesions of recognized bacterial ctology respond favorably to radiation. Many theories have been advanced to account for this, such as increased phagocytic action of the blood-cells, production of bacterially to the enzymes, and one investigator was able to demonstrate an increased opsome index after radiation. Whitever the explanation of this may be, the fact rumains that areas radiated do tend to become free from bacteria as is well illustrated in the treatment of diphtheria-carriers, the cultures from whose throats become negitive after one or two exposures.

## RADIODERMATITIS

Following an X ray exposure there is, is his already been stated an inhibition of all tissues. If the amount has been small, a return to normal will occur in a short time without any physical manifestations. If, however, the exposure has been of sufficient intensity, there will follow in a period of from a few days to two weeks, an erythema or radiodermatus. This must not be confused with the crythema which frequently appears

Idiosyncrasy -- Severe reactions occurring when the exposure apparently has not been excessive, are explained by o called Yray idiosyncrase

As technic improved, untoward results became le's frequent, and to day the existence of true idiusynerisy is demed by the best workers Exposures which produce unexpectedly severe reaction can usually be traced to some error in judgment or maccuracy in technic There may be a hypersensitiveness and certain conditions do influence

the action of the ray. A blond kin is more sensitive than a brunette The flevor surfaces of the body are more sensitive than the extensors Age is a factor children being more susceptible than adults and a young adult more than an aged person. Certain drugs enhance the action of the ray and positive information as to the length of time since their last use must be obtained before arradiation is determined upon

One of the most constant sources of danger as maccuracy of the mills amperemeter a slight variation in its reading being a frequent source of error in exposure To aroud this two milliamperemeters should be used in series. If this is impossible the one employed should be tested frequently. All factors must be maintained constant during an exposure sinco a variation in any one means a change in all

The area surrounding the part to be arradiated should be protected. and mure through failure to use this precantion is unjustifiable. During exposure the patient must be constantly under observation for any one of the many accidents which might occur may result in the death of the patient unless the operator is prepared for the emergency locurate records of every detail of the treatment must be kept as in radiotherapy the medicole, al aspect must be constantly borne in mind

The following drugs should never be employed within two weeks precedin, during nor two works subsequent to the use of Yray. In the ordinarily used formulæ they are keritopla tic and in strong solutions they are keratolytic X ray lowers cell vitality in all tissues. When this occurs in an area where these drugs have been used this action becomes more powerful and the keratelytic action of the drug follows

Todin Indoform Resort III Oil of Cade Coal tar Preparations Lotia Alba Silver Nitrate Stronger Mercuria: Prepara tions Tee

Mustemle Baume Analgesique Beta Naphthol Chrysarobin Gasoline Benzin Turpentine Scarlet Ped Snlphur

Heat

is more likely to degenerate into a prickle-cell epithelioma, the unal result is an indolent inleer

Treatment—I set Degree —The first degree usually requires no tratment. If the burning or stelling is annoving, a lotion of calamin and zine in witch lived may be used. One or 2 per cent carbolic acil may be added. Unguentum aquee rolat or vasilin may be all that will be required.

Second Degree —If there is no resiculation, the calamine and zigmay be used, or an ountment containing 1 to 3 per cent relived may be used in combination with one out.

> Is Ichthral—1 to 3 per cent /mc Oxid Ung Aq Rosa

To this may be added phenol 1 to 2 per ecut, or menthol gr 1 to 3 for exculation and evudation are present, a wet divesing, as to be preferred, but it mut be borne in mind that the excidation (degenerated) products) is extremely irritating, and, wherever it comes into contact with the normal skin, will give rise to an acute exermation condition to avoid this, the surrounding normal insue should be covered with a layer of vise lin before the wet dressing is applied. If he following dissenge suggested by Dr David Saturderin, will be found of service.

I)	] arts
Boracic Acid	4
Sodium Chlorid	10
Sodium Bierrhouate	10
Aq q s ad	100
Apply locally	

Third Degree —The most marked symptom of third-degree radioderinatitie is the system pum, and it is to this that the principal treatment must be directed. While local applications may afford some relief, it is frequently necessary to resort to internal inchestion. In mill cases the coal tar products will be sufficient, but in system one it may be necessary to resort to morphin or codem. These drugs must be used with extreme caution to avoid the danger of drug addiction.

The wet dressing of loracic and may be used or an ointment containing 5 to 10 per cent of anisotherin will often afford some relief. After separation of the slough, the pain becomes less severe. At this stage an ontiment of rethod, I to per cent is indicated.

If an indolent ulcer results healing may be produced, or at lead

aided, by use of the Kromayer or Alpine sunlamp

In extreme cases, or if healing his not taken place in a year it is advisable to excise the entire affected area and skin graft

in the upper scale changing to a vellowish green and that it was difficult to obtain fresh bands, made their use impractical

In 1916 the author, in collaboration with Dr. Witherbee conducted a series of experiments to devise if possible a means of measuring X rav dosage by the use of definite factors-spark gap milliamperage, time, and distance-in order to obviate the use of pastille and radiometer. The results of the experiments were published in 1917

In measurement of photographic intensities it was shown by Shearer that by doubling the voltage, four times the amount of radiation and that by doubling the distance one-enarter of the amount reaches the plate His formula was as follows

For convenience, suppose the following factors are taken

4 Minutes
20 Inches Distance
then 
$$\frac{3 \times 5 \times 20 \times 4}{20 \times 20} = \frac{2000}{400} = 5$$

If the voltage be doubled the intensity will be increased four times as expressed by the following formula

$$\frac{10 \times 10 \times 20 \times 4}{20 \times 20} = \frac{8000}{400} = 20$$

However when this rule was applied to X ray doonge from the stand point of pastille measurement it was found that doublin, the spark gap mstead of increasing the intensity four times as would be expected from the reentgenographic formula only doubled it. It was further hown that the pastille maisurement corresponded to the biological effect on the skin Thus the formula for measurement of unfiltered & ray intensity in radio therapy 18

Having established an equation using the factors necessary to produce a certain biological or pastille effect the result could be repeated on dif Benzoic Acid Balsam of Peru Mustard Stronger Ammonia
Preparations
Chloroform

The action of the following drugs, in connection with  $\lambda$  rav, has been definitely determined, and they should be used with extreme control.

Camphor	Chloral	Menthol
The following drugs	mny be used	
Phenol up to 2 per cent Alcohol	Zine Oxid Boracie Acid	Icthyol 1 to 3 per cent Calamine
Magnesium Carbonate	Bismuth	Pay Rum
Laselin	Lanoba	Ether

# Pierie Acid METHOD OF COMPUTING X RAY INTENSITY OR DOSAGE

#### HERITEPED RADIATION

In radiotherapy it is necessary to establish an accurate method of measurement of the quantity of A ray administered

measurement of the quantity of \$\(\lambda\) ray administered In 1904 Saburaud and Noire devised the first practical means of measurement, making use of Villard's discovers that the platinocamal of barium is colored by exposure to the \$\lambda\) ray. They found that when exposed to in amount of radiation sufficient to depliate the scale, the color of this chemical changed to orange. They then made a radiometer having a scale of two colors, the first which they called time \$\lambda\), "corresponding to the orange. By exposing a fresh pastille of barioplatinocyanid to the \$\tilde{X}\) ray and comparing it to the standard scale, the operator was able to determine the so-called erythema exposure.

Later, Holzknecht devised his radiometer which was without doubt the best instrument for use with pastilles Utilizing the same principle as Sabouraud and Noire, he established a color scale with finer gredations. Such a scale was necessary in order to give fractional treatment. The different shadings were called H 1, H 2, etc., H-4 being the amount necessary to deplate the scalp and H 2 the equivalent of tint 'B' of Sabouraud and Noire. This scale was graduated to H 32, or 8 skin units.

The fact that the pastilles made by the various manufacturers were not uniform, that unless carefully preserved they were hable to change color, that the celluloid band or index was not permanent, after a time in the upper scale changing to a yellowish green and that it was difficult to obtain fresh bands, made their is e impractical

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In measurement of photographic intensities it was shown by Shearer that by doubling the voltage four times the amount of radiation and that by doubling the distance one-quarter of the amount reaches the plate. His formula was as follows.

For convenience, suppose the following factors are taken

20 Milhamperes

4 Minutes

20 Inches Distance  
then 
$$\frac{5 \times 5 \times 20 \times 4}{90 \times 20} = \frac{2000}{400} = 5$$

If the voltage be doubled the intensity will be increased four times as expressed by the following formula

$$\frac{10 \times 10 \times 20 \times 4}{20 \times 20} = \frac{8000}{400} = 20$$

However when this rule was applied to X ray desage from the stand point of pastills measurement it was found that doubling the spirk, gap instead of increasing the intensity four times as would be expected from the reentgengraphic formula only doubled it. It was further bown that the pastille measurement corresponded to the buological effect on the skin fluis the formula for measurement of unfiltered X ray intensity in radio thrapy is

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Stronger \mmonia Preparations Chloroform

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ciution		
Camphor	Chloral	Menthol

The following drugs may be used

Phenol up to 2 per cent
Alcohol
Magnesium Carbonate
Vaselin
Phenol up to 2 per cent
Alcohol
Boracie Acid
Calamine
Bay Riim
I anolin
Phenol Acid

# METHOD OF COMPUTING X RAY INTENSITY OR DOSAGE

#### UNFILTERED LADIATION

In radiotherapy it is necessary to establish an accurate method of measurement of the quantity of X ray administered

In 1904 Sabanraud and Nore decised the first practical means of barnim is colored by exposure to the Xrav. They found that when exposed to an amount of radiation sufficient to depilate the scalp, the color of this chemical changed to orange. They then and a radiometer having a scale of two colors, the first, which they called timt "A," corresponding to the unexposed chemical, and a second, cilled timt "B," corresponding to the orange. By exposing a first pastille of barroplatinocy and to the Xray and comparing it to the standard scale the operator was able to determine the so called erythemy exposure.

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The fact that the pastilles made by the various manufacturers were not uniform, that unless circfully preserved they were hable to change color, that the celluloid bund or index was not permanent, after a time What would be the distance required to produce 1 skin unit, using the following factors 3 inch spirk pap 3 milliamperes 16 minutes t

$$\frac{3 \times 3 \times 11}{D \times D} = \frac{144}{D}$$

$$\frac{144}{D} - \frac{36}{64} = \frac{144}{D} \times \frac{64}{36} = \sqrt{\frac{236}{D}} = 16 \text{ inches (distance)}$$

What would be the amount of radiation produced using the following factors: 6 inch gap 3 milliamperes — minutes, at 8 inch distance'

The following experiment was also done

EXPERIMENT SHOWING TIME FOR ONE UNIT

M	li mper	hpa k G p	Dι	To	Sk U t
(1)	3	3	8	9	1
(2)	3	6	9	2	1
(3)	۲	•	8	2	1
(4)	3	6	10	9	ŧ

From the above experiments the following rules can be deduced

- Doubling the spark gip or milliamperage doubles the amount or halves the time
  - 2 Doubling the distance quarters the amount or quadruples the time

# FILTERED RADIATION

According to the pastille measurement twice the amount of radiation, or  $2^{12}$ , skin units is required to produce in crythems when a filter is interpoled.

In the estimation of filtered interests or dosage the method differs for while in unfiltered radiation there is one standard formula in filtered there must be a formula for each thickness of filter employed. Further divergence from the photographic formula is noted in that the intensity ferent patients, using the same or different machines. It was also found that by using this formula other factors could be substituted and the same results obtained by arithmetical computation, and that three factors being known, the fourth could be computed.

In pastille readings with the Holzknecht radiometer H1 is used as the unit of inersurement, and represents one fifth of the amount of radia tion necessary to produce an erythem. Four times this (H-4) is the amount necessary to depilate the scale without causing a permanent alopecal, and is the so-cilled "skin unit".

The studard formula for 1 skin unit, using a 3 inch spark gap, 3 milliumperes, 4 minute time, at 8 inch distance, is

$$\frac{3 \times 3 \times 4}{8 \times 8} = \frac{36}{64}$$

Any or all factors may be changed, and given int three factors the fourth may be obtained by the following rules

- 1 To determine milliamperage, spark gap, or time, the standard formula is used as the dividend
- 2 To determine distance or amount the standard formula is used as the divisor

# L'amples

What would be the time necessary for one unit, using a 6 inch g2p, 3 milliamperes, and 8 inch distance?

$$\frac{6 \times 3 \times ?}{8 \times 8} = \frac{18}{64}$$

$$\frac{36}{64} = \frac{18}{64} = \frac{36}{64} \times \frac{64}{18} = 2 \text{ (minutes time needed)}$$

It therefore follows that if the spark gap be doubled, and the time reduced one hilf, the same amount of radiation will be produced

What spark gip would be necessary to produce 1 skin unit using the following factors 3 milliamperes, 2 minutes, 8 meh distance?

? × 3 × 2 6

What would be the distance required to produce 1 skin unit, using the following factors 3 inch spark in 3 milliumperes 16 minutes?

$$\frac{3 \times {}^{\circ} \times 1!}{D \times D} = \frac{144}{D}$$

$$\frac{144}{D} - \frac{^{\circ}f}{64} = \frac{144}{D} \times \frac{64}{36} = \sqrt{\frac{336}{D}} = 16 \text{ mehes (distance)}$$

What would be the amount of radiation produced usin, the following factors 6 inch gip, milliumperer  $\rightarrow$  minutes at 8 inch distance  t 

$$\frac{6 \times 3 \times 3}{8 \times 5} = \frac{90}{64}$$

$$\frac{36}{8 \times 5} = \frac{90}{64}$$

$$\frac{36}{100} = \frac{90}{100} = \frac{64}{100} = \frac{5}{100} = \frac{21}{100} \text{ (skin units)}$$

The following experiment was also done

EXPERIMENT SHOWING TIME FOR ONE UNIT

Mil mper by k	Gp Dt	Τta	9k U t
(1) 3 3	8		1
(י) א } 6	8	) - !	1
(3) 6 3	8		1
( <del>1</del> ) 3 6	16	9	1

From the above experiments the following rules can be deduced

- 1 Doubling the spark gap or milli imperage doubles the amount or babes the time
  - 2 Doubling the distance quarters the amount or quadruples the time

# FILTERED RADIATION

According to the postilk measurement twice the amount of radiation or 21% skin limits is required to produce an erithema when a filter is interposed.

In the estimation of filtered intensity or dosage the method differs for while in unfiltered relation that is one standard formula in filtered there must be a formula for each thickness of filter employed. Further divergence from the photographic formula is noted in that the intensity varies inversely with the distance instead of with the square of the

Also the time factor in filtered radiation differs from that of un filtered in its action on the skin and pastille, for while in the latter doubling the time doubles the amount, in filtered radiation the increase in the pastille reading depends on the spark gap or voltage in connection with the filter employed. When a 6 inch spark gap is used and the time required for 1 filtered unit is doubled, the reading is 1½ filtered unit instead of 2. Repeating this process advances the reading, ¼ filtered unit. When a 7 inch gap is employed, doubling the time products 1½ filtered units, and the redding then advances at the rate of ¼ filtered unit for each exposure. Using an 8, 9 or 10 inch gap advances the reading and then advances at the rate of ½ for each exposure until 2 filtered units have been reached, and then advances at the rate of ½ filtered units.

The only exception to this rule is where 5, 6, or 7 millimeters of aluminum are used when doubling the time advances the reading to ?,

and then at the rate of \( \frac{1}{2} \) for each exposure up to 3 filtered units

The following formulæ have been established for the different thick
nesses of aluminum filter employed

The thickness of these filters ranges
from \( \frac{1}{2} \) to 7 millimeters

FORMULF FOR ALLMINUM PILTER

Millimete s of	Spa k G p	M 11 mp res	II st I h	Tim	St ad d
ŧ	9	5	10	0 min 42 sec	20 99 20
1	0	5	10	1 00 '	70 171
1	9	, ,	10	1 04 "	70 91
2	9	5	10	9 20	171 70 91 2 231 20
3 4	9	5	10 10	g ~4 4	18
5	9	5	10	7 '	2
6	9	' }	10	7 "	63 2 63 2 63
7	9	5	10	7 '	2

This fact Las been disputed and a still a matter of contention between the physiciats and the author of this paper. While from the plysociats pound of view their contention based on the action of the ray on the photographic plate and the ionization chamber is correct from the Hological standpoint and the experience gained by the u of the formula for the parts at any years I we many ratiothers pentiate its correctness up to 110 000 volte and 7 millimeters of aluminum has been fully established.

To illustrate the difference m rading when the time necessary to produce one filtered unit is increased, the following table from Witherbee and Lemars original article is copied—in each instance the filter being 3 millimeters alumnium

DIFFERENCES IN READING SHOWN

Sp k G p	М Цантр	D t	Tm	Fitered U it
6	J	10	3 mm 51 sec	1
6 6	( ,	10	7 mm 42 sec	11/4
6	U	10	11 mm 33 sec	11
8	5	10	15 mm 94 sec.	134
6		10	19 min 15 sec	2
7	5 5	10	3 mm 15 sec	1
7	5	10	6 min o6 sec	11/2
7	,	10	9 mm 54 sec	13,
7	5	10	13 mm 12 ⊧ec	2
7	1 5	10	16 mm 0 sec	21/4
777777777777777777777777777777777777777	٠ ا	10	10 mm 48 sec	21/
7	5 5	10	23 mm 6 sec	234
7	5	10	2° min 28 sec	3
8 8 8 8	5 5	10	2 mm 3 sec	1
8		10	5 min 46 sec	11,
8	٥	10	8 mm 9 sec	2
8	5 5 5	10	11 mm 32 sec	234
8	5	10	14 min 95 sec	212
8	5	10	14 min 18 sec	431
8		10	20 mm 11 sec	4
9	5	10	2 mm 34 sec	1
9	5	10	5 mm B sec	11,
9	5 5 5	10	7 min 49 sec.	4 .
9	5	10	10 mm 10 sec	21/1
9	5	10	12 mm v0 sec	-17
9	5	10	15 mm % sec	537
9	5	10	17 mm 58 sec	4
10	5	10	2 min 19 sec	1
10	5	10	4 mm og sec	11/2
10	5	10	6 mm 5 sec	2
10	,	10	9 mm 16 sec	214

The mathematical computation for filtered radiation differs somewhat from that of unfiltered in that it is always necessary first to find the time required for I filtered unit, and this must be multiplied by the number of times this exposure must be repeated to obtain the desired amount राज्यक व्याप्यकार कार्य यात्र देशीयक व्याप्यांने रह कार्य यात्र कुण्या सर्वे व सर्वाया करें

Le lumine de le different miliere differe com du la meforme on de sero med de fin end puelle for relle a de une son de la come o mes de em end formille for relle a de une de la finale rectue apen, en de seus en le resque a mode de van de fir s'emparen. The selfand forme par en mode en empare for a distribute de greens affende de registre, dies armes est a finale en la greens affende de registre, dies de mode de la finale en la greens affende de me par en el p forme mandada de registra des serves est de mode for en la descence. Esquien en la certa de mode de mode de la descence de la competita militation de mode de mode.

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To illustrate the difference in mading when the time necessary to produce one filtered unit is increased, the following table from Witherbee and Remors original article is copied—in each instance the filter bing 3 millimeters shimnum.

DIFFERENCES IN I EADING SHOWN

Sp k G p	34 11 mp	ו מ	T m	Filt d Unit
6	5	10	3 min 1 sec	1
6	5	10	7 mm 4 sec	11/4
6	v	10	11 mm 33 sec	11/
6	5	10	15 mm 24 sec.	134
6	5	10	19 mm 15 sec	2
7	5	10	3 mm 18 sec	1
7	5	10	6 min 36 sec	11/
7	,	10	9 mm 4 ec	13,
'n	U	1 10	lomin 12 sec	2
7		10	16 mm =0 sec	21/4
ż	ă	10	19 min 44 sec	21, 234
7	5	10	9 min 6 sec	284
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5	10	26 min. 28 sec	3
8	5	10	2 min 3 sec	1
8	J	10	ormin 4f sec	11/2
8	5	10	8 mm 9 sec	2
8	5	10	11 mm 39 sec	274
8	U	10	14 mm 95 sec	21
8	5	10	1. mm 18 sec	234
8	5	10	90 mm 11 sec	3
9	5	10	2 min 34 sec	1
9	5	10	5 mm 8 sec	11/2
9	5	10	7 mm 42 sec	2
9	5 5	10	10 mm 16 sec	214
9	5	10	12 min 50 sec	21/
9	5 5	10	15 mm 24 sec	23/1
9	5	10	17 min 59 sec	3
10	5	10	2 mm 19 sec	1
10	5	10	4 mm 39 sec	11/
10	5	10	6 mm 5, sec	2 21/4
10	1	10	9 mm 16 sec	21/4

The mathematical computation for filtered radiation differs somewhat from that of unfiltered in that it is always necessive first to find the time required for I filtered unit and this must be multiplied by the number of times this exposure must be repeated to obtain the desired amount

## Examples

What would be the time required to give an exposure of 2 filtered units using the following factors 7 inch spark gap, 4 milliamperes, 1 milliamperes, 12 milliamperes, 13 milliamperes, 12 milliamperes, 12 milliamperes, 13 milliamperes, 12 milliamperes, 13 milliamperes, 13 milliamperes, 13 milliamperes, 14 milliamperes, 14 milliamperes, 14 milliamperes, 15 millia

$$\frac{7 \times 4}{12} = \frac{28}{12}$$

The standard formula for 1 millimeter of aluminum is  $\frac{171}{20}$ 

First find the time required by dividing the standard formula by  $\frac{v_b}{12}$ 

 $\frac{171}{20} - \frac{28}{12} = \frac{171}{20} \times \frac{12}{28} = 3\%$ , or 3 mututes and 40 seconds, time required for one filtered unit

Referring to the above table we find that 4 times this amount is need sary to produce 2 filtured units, therefore 14 minutes and 40 seconds is the required exposure

Unfiltered Treatment—In dermatology the X ray has long been a routine measure, and it was in this branch of medicine that it had it first principal application. In some instances it is curvative where other methods have fulled. In others, it is a valuable adjunct to medication

The advantage of cleanliness, convenience, and absence of pua, and the elimination of the use of irritating and offensive outments, usually commend it to the patient "Often there are economic reasons which make its use more prietical especially for the wage-carrier"

The method used in dermatological work is that of unfiltered ridar A spark gap of 6 to 7 miches, a current of 2 to 5 milliampers, with a target skin distance of 8 inches, unsult, gives the best results. The time and number of exposures must of necessity vary with the nature of the condition under treatment—from one-tenth of an erythema exposure, when the pathological condition is of an acute or subsents minimatory inture to two or more erythema exposures, when it is of the granulomatous or neoplastic type

The methods employed in the treatment are the intensive, the semiintensive, and the fractional

Intensite Treatment -Single exposures of from 1 to 21/2 skin units repeated at four to six week intervals

Semi intensite Treatment—Exposures of from 1/2 to 34 skin unit repeated every two or three weeks

Fractional Treatment — 1/8 to 1/1 of 1 skin unit repeated semiweekly if the 1/8 S U is employed, and weekly if the 1/4 S U is used

Not only is there a pulhological indication for the intensity of exposure, but there is also a technical condition, that is, the character of the

skin, the age of the pytient, etc. Also, the entire body should not be expe ed at one time, owing to too get it a sistemic reaction, acidosis and too great a reduction of the lumphocytes to insure a normal recovery before the time of subsequent exposure

In generalized conditious such as poorisis, generalized cezema and invosis fungoides exposures are preferably given three times a week allowing a day to elapse, between each exposure. The entire body is divided into three areas and these again subdivided. For the first exposure the head and arms are reducted second, the trunk and buttocks and third the legs and thighs.

The head is divided into five areas as in the Adamson Kienbock method for times of the scalp the irms foreigns and hands into six axis each three fevor and three extinsor the trunk into eight areas four ventral and four dor all the buttocks one for each buttock, the legs and thinks into six axis, three auterior and three patternor

The exposure given is 34 skin unit to each area of the scalp one of week until four exposures have been given. Freitment is then discontinued for four weeks and it necessary a second scripe is given and after a rest period of four weeks may be repeated if the condition recuires.

To each of the areas of the body 14, skin unit is given each week until the lesions have disrepeared the treatment usually being concluded in from four to eight week depending on the severity of the case. If it is impossible to follow the above method, which is the ideal one the body is divided into two general area, and exposures made twice a week employing 14, skin unit for each area of the body instead of 14.

# WHEN UNFILTERED RADIATION MAY BE USED

Rosacea Per Se —The does not respond to radiation although the acuc which is usually an accompriment of this condition will be benefited

Lichen Planus — Favorilk is alts are practically always obtained in the treatment of helen planus by irradiation but on the character of the lesions will depend the technic to be employed. The influence of the ray on the severe printitis which accompanies thus condition is marked trequently after the first treatment.

When the disease is generalized the technic given for "eneralized diseases should be followed. In the acute or chronic type ½ shin unit at welly internals should be administered. Usually involution begins after one or two exposures and it care is effected after from 6 to 10 irreductions. In the hypertrophic type of the disease the ½ shin unit is not sufficient to bring about the desired result, so that a subrytherm or opsoure of 1 shin unit is best employed to be, repracted every four weeks.

Small circumscribed patches of ordinary lichen planus respond to frac

tional doses of 1/4 skin timt administered weekly, the individual lesions being isolated, and the surrounding normal skin protected with lead rubber or lead foil

In the verrucous type, owing to the marked hyperkeratosis intensive treatment should be given 11/2 to 11/2 skin units should be administered and repeated in four to five weeks, if necessary Care must be taken to protect fully the surrounding normal skin with lead foil While usually unfiltered ray is effectual in the verrucous type, involution may frequently be hastened by using a filter of 1 millimeter aluminum, an exposure of 2 filtered units being given

Psoriasis -It is doubtful if there is any method of treatment that can compare in favorable results with X ray in the treatment of psoriasis The cleanliness of the method as compared with the use of outment, especially chrysarobin, appeals to the patient, and also from an economic standpoint it is of value, but it must be borne in mind that the disease is incurable and that recurrences are bound to appear sooner or later, the time varying from a few weeks to a year. In one case in the authors practice there was no recurrence for two years

Occasionally there are eases which will not respond to radiation new lesions appearing in niers which have shown improvement, and are under treatment. In a case where the disease is to be influenced by radiation, it will disappear under 6 to 8 treatments of fractional exposures of 14 skin umt given weekly, an improvement being noted after two or three exposures If the disease shows no improvement after 8 to 10 ir radiations at as well to discontinue the X ray treatment

When the discuse is general, the method suggested for generalized diseases should be followed Should the sculp be involved, no more than a total of 1/2 skin unit, divided into neekly exposures of 16 skin unit each, should be given One course should be sufficient to cure, but if not there should be an intermission of four weeks, after which the treat ment may be repeated. The five points used in timea tonsurius are used in treating the scalp although accurate measurements are not made

If the lessons are of long standing and there is much thickening, good results may often be obtained by the use of 1 millimeter of aluminum

filter, 1/2 filtered unit being administered every one or two weeks

Recurrences - While it is permissible to treat recurrences in the manner above outlined Judgment must be exercised in the use of the ray, and it must be borne in mind that too prolonged radiation, even in fractional doses, may cause atrophy of the skin and underlying tissues, which will be followed by telanguectess a

Psorrasis of Face - The same technic should be followed in this con dition as in some of the face Psoriasis of the hands and feet yields to the same technic as psoriasis of other parts of the body. It is often necessary to expose both the dorsal and palmar surfaces If both hands

are affected, it is best to irradiate each hand separately and, in exposing the palmir surface, to measure from the highest point that is the thenar eminence Fach foot chould also be exposed separately.

Psorasis of Noils—This condition is more resistant to irradiation, and frequently ten or twelve treatments are necessity to produce satis factory re ults. The skin about the nulls should be protected, as in priorychia or similar nail conditions.

Eczema —Probably us no dermatological condition has V ray a wider

Eccent — From the the capeta salue than in eccena both in the scute and chrome types. As early as 1900 it was used with bencheral results but with the more definite knowledge of the conditions which are now classed under the general heading of eccent its use and application have become more general and efficacious.

In the earlier history of the  $\Delta$  ray for this condition it was thought that permanent elimical curse could be effected, but this has been found to be erroneous. There are apt to be recurrences the time of recurrence, varying with the different causes and types of the disease

The respon e of eczema to the riv is usually very prompt, frequently being manifest after the first or second exposure. Among the early symptoms to be relieved as the intense prairities.

The intensity of the exposure of Roenigen ray in the therapy of eccess depends upon the principle that the more acute the inflammatory process the less the intensity of exposure required and, conversely, the more chronic the process that is the types associated with thickening namely acanthosis and connective tissue hypertrophy or hyperplasis, the grater the intensity required to cave, absorption

Technic —When the condition is generalized the body should be divided into areas and treated as previously, described. When the lessons are isolated each lesion should be treated individually the surrounding healthy kin being protected hy lead. For mild acut or subveute types, exposures of from 3 4 to ½ unilitered skin unit should be made every the e to seven days. For the more chrome types exposures of from ½ to 34 of an unilitered skin unit should be administered every two or thric weeks.

Frequently in the use of the unfiltered ray, especially in the indurated types ab orption will be slow. The prolonged use of the X-ray which may be necessary, may produce strophy and subsequent telenguectary. In such cases the use of filtered exposures is indicated the amount of tanchening and the penetration of the rat desired determining the thickness of the filter to be employed that is, from 1 to 3 millimeters of aluminum. The exposure should be ½, to 1 filtered unit administered evers seem to fourteen days. In the mild scute and subscute types, from six to time responsives will nasully produce a chinacle cure, in the more chronic types especially where there is much thickning, a longer time usually will be required.

The intensity of the exposures and the intervals between the exposures whether filtered or unfiltered, will depend upon the clinical status of each individual case

The employment of X rv in eczema does not by any means probabt the use of drugs which may be of value in connection with the ray, such as zure, borte acid, calamine, hismith mild preparations of ammonated increases etc. (see complete list of permissible and contra indicated drugs) in the form of powder, lottons, pistes or creams, as indicated

Lupus Vulgaris—Although opinious differ regarding the results obtained in the treatment of lipus vulgaris by arradiation, in properly selected cases its value cannot be overestimated. In the attophic type of the disease the ray has little or no effect. Not only will satisfatory results not be obtained, but the prolonged treatment that is necessar will result in injury to the skin and underlying tissues. It is in the hypertrophic and ulcerative type that X ray is applicable, and in these types the results will prove not only kenefecal, but highly gratifying

Pechnic —The intensive or subervhema method should be employed rather than the frictional, and, as the disease occurs at all ages and if teets various parts of the body, on the age of the patient and location of the lesions must depend the intensity of the exposure. From ½ skin unit in thickness to from 1 to 1½ skin units in the case of adults should be administered and repented at intervals of from four to five weeks. It is wise to begin with exposures of lesser intensity (½ to 1 skin unit) and, if not followed by improvement, to increase the amount of radiation and exposures are avoided if possible, particularly when the lesion is situated on the face. However, if the condition does not respond to suberythema exposures, the discase warrants producing an erythema, even though a subcquient strophy and telas, lecture may result. In irridist no, it is important to expose beyond the border of the lesion so that from ½ to ½ inch of normal skin is included in the field irridiated. The surrounding, normal skin should be protected by led. There may be recurrences and these should be treated in the same manner as the

Lupus Erythematosus—Irradiation in this disea is misatisfactor, and is not advised While in the early inflammator; stage, beneficial results may be obtained, later there is an "end results' of a chronic in flumintory process, with atrophy and telanguectiasia. If treatment is under taken, the fractional method of ½ skin unit at weekly internals should be employed and if affer four or five treatments there is no improvement, a change of technic is advised, administering from 1 to 1½ skin units every four to five weeks.

Mycosis Fungoides —Although mycosis fungoides is meurable marked relief can be afforded, a temporary chinical enre effected, and the life of the patient prolonged by X ray There will always be recurrences and the discrese will ultimately prove fatal. One of the marked symptoms the almost intolerable prurstus can be controlled and is among the first symptoms affected. Mycoas imagoids presents its own indication for the frequency and intensity of the exposures. When the di-case is generalized, particular caution must be exercised in the treatment as the discass seems to be extremely sensitive to X-ray and the patient particularly susceptible to assessme reaction.

Technic.—In undertaking the treatment it is well to be, in with cx poures of small intensity and it well tolerated to increase the amount after two or three exposures have been administered. In the pictungoid, non-infiltrated stags, capically it the condition is widespread it is best to be, in with exposures of 1g shar unit exposures it weekly intervals. After three or four weeks this may be increased to 1g shar unit weekly. Too prolonged radiation should not be, and as an immunity may be established. In such a case an intivial of rest should be allowed after which treatment may be resumed with beneficial effect. If the discusse is not generalized but consists of only isolited non-infiltrated plaques, the plaques should be irraduated individually the surrounding healthy skin being protected, and the same intensity of exposure being employed as when the discusse is generalized.

Mackee advises a differential blood count every two weeks and if there is an increase in the lymphocytes or if there is any cyldence of tovernia,

that irradiation be temporarily discontinued

In the fungoid stage of the disease fractional treatment will not suffice, and subcritient exposures of 1 shin unit every four weeks should be administred. If, after the first irradiations there is not musked in proteinest the intensity must be increased to 1½ to 1½ skin units repeated when the erithemy has subsided. Although generally responding to unfiltered radiation, occasionally better results can be obtained by the unit of a fifter especially if the tumor has attained a considerable size. Using a fifter of 3 millimenters of administration are considerable size. Using a fifter of 3 millimenters of administrated and repeated in four weeks, if necessary

In severe cases and in the late stages of the disease when the condition may be regarded as systemic Jadassohn advices the following technic The body is divided into six areas and using, as I such spark gap, 5 milliamperes and a filter of 3 millimeters of aluminum \( \frac{1}{2} \) filtered unit as examinated each day for as days one area being irradiated at each exposure. A rest period of four days is then allowed following which a second series of irradiations is given again followed by a rest period of four days and a sub-quent third screen of trenuments. Jidassohn claims for this method that not only is there no deleterious systemic forms for this method that not only is there no deleterious systemic reaction, but on the contrary there is an appreciable improvement in the disease testel and in the general height of the patient.

The intensity of the exposures and the intervals between the exposures, whicher filtered or unfiltered, will depend upon the clinical status of each individual case.

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Thea Tonsurans and Favus—No other method is as prompt and electrons in the treatment of this common and disagreeable condition as is radiation. In crowded enters, where a large, number of children are affected, the disease becomes not only a musuice, but alo an economic problem. Unless a complete depilation is accomplished, a cure without recurrence cannot be expected. In many instance, but one or two isolated patches may be found, but even in these it is important to depilate the entire scilp, for if only the single priches are treated, the falling hair will affect healthy areas, and ultimately a complete depilation will be

By employing the Adamson Arenbock method of measurement of the scalp and using the Coolidge tube and interrupterless trunsformer, an entire scalp can be deputated in from three-quarters to one hour

Truca.—A marker for the measurement of the scalp has been devised by Dr. George, Andrews, which permits of accurate measurement with a marked saving of time. While in the hands of a completent operator this method of treatment as simple, and the results accomplished are gratifying, in word of warning should be sounded, for unless there is absolute accuracy in every detail, there is great danger of permanent alopeous, if not more seemas results.

Before irradiation it is most important to ascertain whether or not the prittent has had any previous application of the ray to the scilp, or has been mang any irritating drags, such as salleple acid, Jodin, incremely, etc. If any such drug has been need, it is best to delta treatment for at east two weeks after the last application, as failure to do this may result in a radiodermatite, or permauent alopeen. It must also be remembered that no irritating application should be used for two weeks following the treatment.

It is made is ble to attempt to administer treatment to a child under four or five years of age, owing to the difficulty of keeping it quiet. There are, of course, exceptions, as often younger children can be irriduated successfully.

The barr should be clipped close. This not only permits of easier marking, but allows the full amount of ray administered to reach the scalp (The hair, if thick, filters out a definite amount of ray.). Also, all serbs and crusts should be softened and removed with vasclin or a non-irritating soap and water.

Technic Marking—Meisure from the anterior to the posterior hair line, subtract 10, divide the remainder by 2. The quotient will give the number of inches used, the anterior and posterior hair lines, that is, the frontal and occupital points, and the mersurement between the c two points should be 10 inches. A point individual between these in the median line will mark the crown point. Meisure downward from the crown point 5 inches on each side for the princial point. There then should be exactly

5 inches between all points - The circumference of the head should measure 20 inches

For example, suppose the distance from hair line to hair line is 41 inches. Subtract 10, which leaves 4 Doudt this by 2, which gives 2 inches the distance from the auterior and posterior hair lines. The frontial point will be 2 inches posterior to the anterior hair line and the occupital point 32 inches interior to the posterior hair line. The distance between these two will be 10 inches. The muther above referred to obtain test the necessity of making these, measurements.

In ome cases the distance from hair line to hair line will be found to be exactly 10 inche. In such an exact the anterior and posterior hair hirs will coincide with the front I and occupited points.

Again it occasionally happens that the circumference of the head will measure 10 or 31 inches. In such cases 14 meh should be added or subtracted from the 5 inches between points.

Lines are drawn joining each point, which will divide the scilp into four transfes. This will be found of great advantage in determining the anile for each point of exposure, which must be at right angles to every other point.

Exposure—Having determined the exist points the procedure is as follows with the child lying on the back, the head is turned to one side so that the line of the chin is on a lovel with the shoulder. The face be low the hair line is covered with lead foil. An epiliting exposure is given to the parietal point. The bend is then turned to the other side and the opposite prietal point is exposed. Lying with the free upward and hielded with lead foil the frontial point is next exposed. Then with the child lying on the abdomen and resting on the chin the cown point is exposed. The lead is then titled forward so that it rests on the forchead and the occupital point is irradiated. Lead foil is placed over the back below the hart line.

Although various distances and other factors are used the following used at the Vanderbilt Claine will be found convenient spark gap 6 inches 3 milli imperes, 6½ mild instance and 1½ minutes time. This will give 1 shin unit, an exposure sufficient for epilation

At approximately the end of the third week, the hair will begin to fall and the scalp will be deplated at the end of the month. The hair will begin to grow again in from one to two months. In from four to five months it will have entirely returned. If there is not a new growth of hur at the end of a w months there will be permanent alopecia.

After a scalp has received treatment it is well to wish the head three or four times a week with soop and water, and, when the hair has fallen, to use a mild parasitic outtened. A linen cap should be worn during the time deflutium occurs

All fallen hair should be burned to prevent infection of others

Recurrence is unusual, but if there should be a reinfection, a second depilation should not be done for at least five or six months

I at us — This condition is more resistant, and it is frequently necessary to depilate a second, or even a third, time before a complete cure is effected. The same technic is employed as in time a tonsurant

Blastomycosis and Actinomycosis —Irridiction probably is superior to any other form of treatment for both these rather uncommon conditions. Where the lesions are situated on the skin, unfiltered radiation will give sufficient penetration to eradicate the condition, but if the deeper us sues are involved, better results will doubtless be obtained if a filter of diminium of from 1 to 3 millimeters is used, depending upon the depth of the lesion beneath the surface

In superficial lesions from one to three intensive exposures of 1½ to 2 skin units are given at intervals of from four to six weeks. Not in frequently a single treatment is sufficient to cause disappearance of the disease, but even in such a case, a second exposure is advisible as a prophylactic measure.

In the treatment of lesions situated in the deeper structures, 2 to 214 filtered units should be administered

Pruritus—The antipruritic action of the \(\) 1 ay is often remarkable in dormatological conditions. This is especially true in the prurities of eczuni psoriusis, and lichen plums, the severe itcling often being relieved before any manifestation of involution of the disease. This may be or probably is due to the effect on the terminal nerve filaments.

Pruritus Ani et Vulvæ—Sitisfactory and even brilliant results are relief can be obtained. This relief will lest from a few months to a vear or more, and in a proportion of the cases will be permanent after one course of radiation. Freatment should not be instituted until all possible causes have been investigated and eliminated. When the anus is the only site of prurities, the patient should like on the abdomen holding the buttocks apart with the hands. If, for any russon this is unpossible, ad heave strips may be used. When both the unus and vulva or scrotim are involved, the patient lies on the back, the knees and thighs fleved in women, the region is divided into two areas, and two exposures are made, first centering the time at the anterior part of the vulva, and then centering it at the anis. The thighs and portions not being exposed should be protected with lend foil

If the scrotum is involved it will be necessary to ray the interior and posterior surfaces separately. To expose the anterior surface, the scrotum is illowed to rest on a sandling placed between the thighs, the panis being held on the abdomen. I end foil is used to protect all surrounding shan not being irradiated. In irradiating the scrotum, care

must be exercised to avoid if possible, producing a temporary sterility

There are two methods of treatment frictional and intensive. If the latter is employed, I shir must should be given every four weeks. It is neither necessary nor advisable to produce an erithemi. This method is not advised, and better results ar usually obtained by the fractional method of treatment. One-quarter shir unit is given weekly until a total of 9 shir units has been given if a satisfactory result has not been obtained before. The author has obtained the best results by the following without

The first weak an exposure of  $\mathcal{V}_2$  skin unit is given the second week  $\frac{1}{2}$  kin unit and for the third, and subsequent exposures  $\mathcal{V}_2$  skin unit, given weekly until a total of  $\mathcal{J}_2$  skin units has been administered. If at the end of six treatments no improvement has taken place it is best to discontinue the treatment by X ray.

Recurrences should be treated in the same manner as the original

Reloid—The results obtained in the treatment of keloid by \ \ ray are in most instances very gratifying. The earlier the treatment can be instituted after the development of the keloid the more satisfactory will be the result and the less trantient required.

In organized and thickened series the treatment is necessarily of long duration sometimes a vear bein, required it a good cosmetic result is to to obtained. In irradiating this condition it is important that an erythema should never be produced.

Technic—The normal skin must be protected to the very edge of the keloid. On beginning the treatment it is advantageous to cut from lead foil a pattern outlining the lesson. This is kept for the individual care and affords a means of accurate measurement of the noprovement.

Where the condition is recent infiltered rivisia ed and a suberythemic exposure of 1 skin unit is administered every four or five weeks. When the condition is of long standing or is abrous in character a filter of from 1 to 3 millimeters of aliminum may be used to advantage and an exposure of from 1½ to 1½ filtered junts administered every four to five weeks.

In the negro it is particularly important that no more than a subcrythema exposure be given, as repeated crythemas are likely to result in depi, mentation

Dermatitis Papillaris Capillitin or Aone Keloid —In the earlier or papular stage unfiltered riv may be employed and the disease aborted, suberythema exposures of 1 skin unit being given every four weeks

In the later stages where the kelondal condition has developed better results will be obtained by employing a filter, the technic being the same as for kelon Recurrence is unusual, but if there should be a reinfection, a second depilation should not be done for at least five or six months

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Prurtus Ani et Vulvæ—Satisfuctor; and even brillieut results are obtained by irradiation, and in practically every case at least temporary relief can be obtained. This relief will last from a few months to a vear or more, and in a proportion of the cases will be permanent after one course of radiation. Treatment should not be instituted until all possible canses have been investigated and climinated. When the anis is the only site of pruritus, the privent should in on the ibdomen, helding, the buildeds apart with the bands. If, for any reason, this is impossible, at heavier strips may be used. When both the anis and vulva or scrotum are involved, the patient less on the back, he haves and highs fixed. In women, the region is divided into two areas, and two exposures are made, first centering the tube at the anterior part of the vulva, and then centering it at the anus. The thighs and portions not being exposed should be protected with lead foil.

If the scrotim is involved at will be necessary to ray the anterior

and posterior surfaces septrately To expose the anterior surface the serotum is allowed to rest on a synding placed between the thighs, the penis being held on the abdomen Lead foil is used to protect all surrounding skin not being irradiated In irradiating the scrotum, eire

four treatments of filtered radiation, the treatment being instituted immediately after electrocoagulation or operation

It is best to expose three small areas on each side of the jaw, extend ing from the symphysis ments to beyond the ramus of the mandible to 13/4 to 2 filtered units every four weeks for three or four apposures. This is impertitive if there is evidence of glandular involvement.

Melanoma —This condition can usually be caused to disappear after there or four intensive treatments with infiltered radiation. If, after the fourth treatment, the condition persists other means should be employed

It has been the author's custom to apply the ray to three concentre areas having the lesson as their common center. In order to accomplish this without danger of overlappin, three pieces of lead foil at least 6 inches square are used. In the first of these is made an opening just large enough to include the lesson. In the econd the opening is made to include the lesson and half an inch of the surrounding healthy tissue. In the third the opening should be mide large enough to include the lesson and 1 inch or more of the surrounding tissue. The piece with this largest portal is first placed so that the lesson is at its center, and an exposure of 1 skin unit is given. All tissue except that in the area being treated should be covered by lead foil. The medium sucception is next placed around the lesson and from ½ to 3,4 is unit given. The smallest portal is then placed so as to expose only the lesson and foy 10 3/4 in unit 2 start.

In this way the lesion receives from 3 to 3½ skin units the amount given depending on the location of the lesion and the age of the patient

A second treatment is administered after the evithema has subsided, which will be at the end of five or six weeks and a third and fourth exposure after the intervals. The prinent should then report for observation every month or two for one vear and further treatment be given if any tendency toward recurrence is noted.

Acme—Probably there is no condition which responds more favorably to X ray treatment nor in which more absolute technic is required than aene. One must bear in mind bowever the danger of overexposure either in excessive individual exposures or in prolonging the triatment to an excessive number of exposures. Property selected cases with accurate application of the ray and proper constitutional treatment will result in a cure in about 95 per cent of the cases. The fractional method is employed.

Technic—The patient is placed in the prone position with lead foil protecting the eyebrows cyclashes and hair. The head is turned to the side, the chin being placed as nearly as possible on a line with the shoulder With the anode centered over the highest point (usually the zygoma), exposures of ½ skin unit are given at weekly intervals to each aide of the face and if there are numerous settle lessons of the chin and fore-

Epithehoma —In the basal cell type of epithehoma, cures are effected in about 95 per cent of the cases, and recurrences are rare if the amount of radiation has been adequate

Technic - Curettage of the growth before radiation is advisable in order to remove the hard pearly border which is usually present, as the removal of this permits the ray to penetrate more deeply and more effectively. The area is covered with a piece of lead foil in which an opening has been made sufficient to expose the lesion and from 1/4 to 1/2 mch of the normal surrounding tissue. This is necessary in order to affect the cells which may he beyond the periphery of the lesion area is given 2 to 21/ skin units. After ten days an crythema appears, which lasts from ten days to two weeks and gradually disappears, the time depending upon the severity of the crythema. The appearance of the crythema is an indication of the inhibition of the tissue exposed. As soon as the erythema has subsided, which is an indication of the recovery of normal tissue elements (usually in from four to six weeks) a second exposure is given If all evidence of the discase has disappeared, the second exposure should be of less autensity than the first, that is from 11/2 to 134 skin noits. If, however, there is still evidence of disease, the second exposure should be of the same intensity as the first. This usually is sufficient to offect a cure. Care must be excressed in the treatment of this condition, as too frequent or prolonged radiation will so inhibit the normal tissue as well as the pathological, that a chronic third degree radiodermatitis will result. If after a third or fourth irradiation a cure

has not been obtained, it is best to employ some other means of treatment. The patient should be kept under observation for a year, and further

treatment administered if there is any sign of recurrence

Prickle cell or Squamous cell Epithelioma —This condition may occur on the skim, mucous membrane, or mucocutaueous junction. If this type is recognized in the early stage, it may yield to radiation if promptly and intensively treated, but on account of its tendency to metastasize, if not disposed and irradiated early, the neighboring glands may have become affected.

The technic of this treatment is the same as that outlined for the basal cell type except that lesions on the vermilion border should be exposed to only 134 to 2 units, since the mucoca is more easily affected than is

the skin

Unless there is marked improvement after the first treatment, surgery or electrocorgulation should be employed. This is especially true of lesions of the vermilion border, which are upt to be purticularly difficult to control, and which from the arrun_ement of the lymphatics, show early metastasis to the submivullars glands.

Whether the lesion be treated by electrocongulation or surgery at as wise to expose the affected area and the submirullary region to three or

four treatments of filtered radiation the treatment being instituted immediately after electrocoagulation or operation

It is best to expose three mall areas on each side of the jaw, extend ung from the symphisis ments to be ond the ramus of the mandable to 1½ to 2 filtered units erery four weeks for three or four exposures. This is imperative if there is evidence of cluddlar involvement.

Melanoma —This condition can usually be caused to disappear after three or four intensive treatments with unfiltered radiation. If after the fourth treatment, the condition persists, other means should be employed

It has been the author's custom to apply the ray to three concentric areas bating the lesson as their common center. In order to accomplish this without danger of overlapping three pieces of lead foil at least 6 inches square are used. In the first of these is made an open ing just large enough to include the lesson. In the second, the opening is made to include, the lesson and half an inch of the surrounding healthtissue. In the third the opening hould be mide large enough to include the lesson and 1 inch or more of the surrounding tissue. The piece with the largest portal is first placed so that the lesion is at its center and an exposure of 1 sain unit is given. All issue evcept that in the area bing treated should be covered by lead foil. The medium sized portal is next placed around the lesson, and from \(\frac{1}{2}\) to \(\frac{1}{2}\) this unit given. The smallest portal is then placed so as to expose only the lesson and \(\frac{1}{2}\) to \(\frac{3}{2}\) this unit is year.

In this way the lesion receives from 2 to 21/ dain units, the amount given depending on the location of the lesion and the age of the patient

A second treatment is administered after the erythemn his subailed which will be at the end of fire or six weeks and a third and fourth exposure after like intervals. The patient should then report for observation every month or two for one var and further treatment be given if any tendency toward recurrence is noted.

Acne—Probably there is no condition which responds more favorably to X ray treatment, nor in which more absolute technic is required than ane. One must bear in numl however tho danger of overexposure either in exce wire individual exposures or in prolonging the treatment to an excessive number of exposures. Properly selected cases with accurate application of the ray, and proper constitutional treatment will result in a cure in about 95 per cent of the cases. The fractional method is employed.

Technic—The parignt is placed in the prone position with lead foil proteing the cyclrows, eveluables, and hair. The head is turned to the side, the chin being placed as nearly as possible on a line with the shoulder With the anode centered over the highest point (usually the zygoma), cyposures of 1/4 skin unit are given at weelly intervals to each side of the face and, if there are numerous actual leasons of the chin and fore-

head, an additional 1's «Lin unit is given to the front of the face at his weekly interval, the tip of the note being in ed as a centering point Csually sixteen exposures will be tolerated, and as a rule are sufficient to effect a cure. The first evidence of clinical improvement will not be noted until 11'4 to 11' units have been given which will be in from five to six weeks. The skin mut be watched curefully, and if there is marked drivines it is an indication for le .cuing the intensity of exposure, or discontinuing treatment for one or two weeks.

All cases bould be carefully watched for the slightest evidence of erythems and at the first su pieron of its appearance treatment should be su pended for one or two week. This can be determined by contract in observing the area about the eyes where the protected and supprotected skin merge. Also the kin should be watched for evidence of stropky, which will first be noted on the chin and about the corners of the month At the slightest evidence of this, treatment should immediately be discontinued.

During X ray treatment at is moderable to use any stimulating applications such as lots allo, sulphur, etc., but an outment of zine or an unique may revee may be applied to advant zer. The affected part hould be weshed duly with soap and warm water. Careful regulation of the diet is important. Fried foods, pastry, eindy, and all rich foods should be eliminated. The bowels should be regulated inshing sure of a movement each day. The diet should be maintained for at least six months after the last treatment.

If after five or say weeks sati factory results are not obtained, or if the le ions are markedly indurated, it is well to u e a filter of 1 millimeter of 1 luminum, administering 1/2 filtered unit (e. Filtered Ivi) eich wek for two or three weeks then 1/2 filtered unit every two weeks for two treit ments, and then 1/4 skin unit infiltered.

Cy tie and Pushular Type—The put this should be exacuted and the routine treatment of 14 skin unit given weekly. In this type of one good is alls are obtained by the use of vaccines in connection with X ray treatments.

When the che t and back are affected the same procedure is advised, three areas being sufficient for the entire back. The anode is centered over the outer edge of each scapula for the upper back. For the lower back one exposure is used, the mode being centered over the spine at the level of the lower border of the rubs.

Recurrences do occur, but only in a small percentage of the case. They are usually mild and respond readth to a second course of radia tion, the time required and the amount of ray nece sary being less. If a prompt response is not observed, it is minuted to persist

Sycosis Vulgaris —Probably no di case will try the ingeninty and patience of the radiotherapeutist more than will seen; for the di case

will often prove most resistant, and it is frequently necessary to depilate in order to effect a cure

As at is sometimes not necessary to depilate, it is well to begin with fractional expositres of ½ skin unit once a week for five or six weeks. If, at the end of this time there is no improvement there remain two alternative methods. First, expositres of a filtered ½ skin unit at weekly intervals may effect a circ. Second depilation may be necessary. If the latter method is employed, extreme caution must be used in order to prevent a permaient alopecia. It is of equal importance that even a mild eigree radiodermatitis should not result as this would be followed later by atrophy and tellargeotesia. In order to produce a definition, 57.16 skin unit should be given once weekly for four expositives. From one week to ten days after the last treatment the hair will usually fall.

Technic—When the discuse is limited to the hearded rigion, exposures are given to five areas The patient's position is the same as in anne

- 1 Center just below the zygoma on each side
- 2 Center just below the angle of the jaw on each side of the neck
- 3 Tilt the head brokward and center met below the chin in the median line. Ctre must be used to prevent overlapping and it may be advantageous to corer with lead foil or bead rubber the parts not being treated. It is importante that no irritating drugs be used for two weeks before during, or two weeks after the trainment

When depilation is complete, a mild ointment of ammoniated mercury (3 per cent) may be used

In the treatment of sycous of other harry regions, such as pubis, axille, eyehrows etc., the exposures are the same. If the eyebrows are

affected it is advisable to cover the evelids with lead foil

Hyperideons and Bromidrons—Beneficial results cui be obtained in this discomforting condition by X-ray frectment. It must be borne in mind that it is only the awest glands which must be effected and that under no condution minst a complete atrophy of these glands be produced Usually there is a decrease in the excussive secretion of the glands in a short time and it is at this period that cantiom must be excressed in order to swod carrying the textiment beyond the point of safety

Technic—Either the fractional or subscribtma method of treatment may be employed, at the discretion of the operator. If the fractional method is chosen, exposures of ½ skin must are administered every week with a total of not over 1 skin must in four weeks. If the subscribtmar exposure is employed, 1 skin must repeated in four weeks is advised.

If the hinds are affected each hand should be irradiated separately the anode being centered at the highest point that is the thenar eminence head, an additional ½ skin unit is given to the front of the face at bill weekly interval, the tip of the nose being used as a centering point. Usually sixteen exposures will be tolerated, and a a rule are sufficient to effect a cure. The first evidence of cluincal improvement will not be noted until 1½ to 1½ units have been given, which will be in from five to six weeks. The skin must be watched carefully, and if there is marked drainess it is an indication for lessening the intensity of exposure, or discontinuing treatment for one or two weeks.

All cases should be carefully watched for the slightest evidence of erythems, and at the first suspice of its prperrince tradiment should be suspended for one or two weeks. This can be determined by contrast in observing the area about the eves where the protected and supprotected skin merge. Also the skin should be watched for evidence of strophy, which will first be noted on the claim and about the corners of the mouth. At the slightest evidence of this, treatment should immediately be discontinued.

During X lay treatment it is inadvisable to use any stimulating applications, such as lotin alby, sulphur, etc., but an outmin it of zinc ovid in unguentim aquer cose may be applied to advantage. If a affected part should be washed daily with sorp and warm water. Careful regulation of the diet is important. Fried foods, pastry, candy, and all rich foods should be eliminated. The bowels should be regulated, making sure of a movement each day. The deet should be maintained for at least aix months after the last treatment.

If after five or six weeks stitisfactory results are not obtained, or if the lesions are markedly indurited, it is well to use a filter of 1 millimeter of aluminum, administering 1/2 filtered unit (see Filtered Lay) each week for two or three weeks, then 1/2 filtered unit every two weeks for two treat ments, and then 1/4 skin unit unfiltered

Cystic and Pustular Type — The pustules should be executed and the routine treatment of 1/4 skin unit given weekly. In this type of aeno good results are obtained by the use of vaccines in connection with X ray

treatments When the chest and buck are affected, the same procedure is advised, three areas being sufficient for the entire back. The node is centered our the outer edge of each serpails for the upper back. For the lower back one exposure is used, the anode being centered over the spine at the level

of the lower border of the ribs

Resurrences do occur, but only in a small percentage of the cases

They are usually mild and respond readily to a second course of radia

tion, the time required, and the amount of ray necessary being less If

a prompt response is not observed, it is unways to persist

Sycosis Vulgaris —Probably no disease will tax the augenuity and patience of the radiotherapeutist more than will evensis, for the disease

in which cases, to all clinical appearances parallel, show greater diversity of results when treated in the same manner

Whether this is because of the reastunce of the patient the type of cancer, or the degree of malignancy of the growth is not clearly under stood, but it is immersally recognized. Ewing recently gare the results of his experiments with  $\lambda$  ray on the cancers of two rats. As fir as it was possible to determine be both macroscopic and microscopic examination, the growths were identical in both animals yet that of one was not destroyed by several times the amount of ray incressary to cause the death of all cells in the other. This seems to indicate that some tumors an more resistant than others, and probably accounts for the widely distinct that the sum of the provided in the other statement so positively made by certain of the foreign in testiguous that the Tethal dose for circinoma is 110 per cent of an erithman dose.

Many cases of carcinoma have been elinically cured by X-ray (and after five or more years have shown on evidence of recurrence). One such acts is still well although, the last treatment was given ten years ago. A better understanding of the methods of treatment and improved technic regiving a greater number of brilliant rasults, and warrunt the hope that the problem may soon be solved. At the present time re ults are not sufficiently uniform to justify the contention of the most enthwaisate adocates that X-ray is the last word in the treatment of carcinoma, and that surgery should be discontinued in all caves. In inoperable conditions the use of the ray offers positive relief of the vurptions, probable prolongation of life and perhaps regression and clinical cure.

In operable cases probably the most efficient treatment and that of firing the greatest possibility of a happy outcome consists in prooper tive reduction to inhibit the timor cells and to minimize the danger of dissemination by operative procedure radical surgical removal of the tomor within two to three weeks and pastoperative radiation as soon after as possible in order to destroy any cells that may have escaped the sur, only kinfts²

One of the greatest stumbling blocks in multigraviery is the problem of metastries. Cases in which the most gratifying results in the local lesion are ostuned within a few months after operation frequently. how wide spread metastasis especially to the hones. Prooperative radiation has seemed to reduce the likelihood of such an unfortunate outcome, and as surgeous begin to realize its advantage and employ it more widely doubt less a decord advaruee will be mide.

In order to perm t the u e of the ray both t fore a d after operation without be s f tm pieric acid prepr t on of the simel field is dvocated noteal f the belor d of mercury and joins preparation usually imployed (see Contra ndicated Duca)

on the flexor surface, and at the metacarpal phalangeal junction for the extensor surface

In irradiating the feet each foot should be exposed, the plantar surface being divided into two areas, and the unexposed area being covered with lead foil. The dorsal surface is next exposed. Centering just posterior to the metatarsophalangeal articulation, ½ skin unit is administered to each area.

In hyperidrosis of the avillae care must be taken to avoid too marked pigmentation, depecially in the female, which may persist for several months and often cruse much annovance. If the fractional method is chosen, ¼ skin unit weekly may be administered but if the subcrythema exposure is given, it is suggested that ¾ skin unit be given and repeated in four weeks

Bromidrosis, which is usually associated with hyperidrosis, can be re heaved and frequently cured by the uso of X ray, the technic being the same as that outlined for hyperidrosis

Hypertrichosis — Without doubt there is no condition which the radiotherapeut at is more often called upon to treat than this. While treat ment has often been undertaken, and while at present new technics are being developed both in the United States and in Europe, until more perfect methods are developed, or the present experiments are more fulls perfected, it should, in the author's opinion, neither be advised nor under taken

In order to produce a permanent alopecan it is necessary to cause a complete atrophy of the hair folliele. The sebrecous and swert glands are less highly organized and more superficial. Therefore in producing an atrophy of the hair folliele, it necessartly follows that there will be produced also an atrophy of these glands, with loss of clastic tissue, which is sure to be followed in from six months to a year by wrinking and relanguedasia. This unfortunate result, not being immediate, gives no warning. From the medicologial standpoint, neither a signed contract with the patient nor a warning of the unitoward results which may follow will protect the radiotherapeutist from legal completations

### WHEN FILTERED RADIATION MAY BE USED

Caronoma —Perh ups the greatest field for X ray theraps, and cut tamby the one that at present is holding the most widespread attention among physicians and lathy alike, is that of caronom. More experimental and research work is being done in the effort to find a dependable cure for this disease than for any other condition, and surely no other field holds so many brilliant promises, and at the same time imposes such discouraging and unforcescen obstacles. There is no burnch of pithology in which the individuality of each case is more clearly demonstrated, not

contrast to the 110 per cent needed to destroy carcinoma. Therefore it would seem that a cure of this condition by X radiation should be easy and certain, and that the most bopeful prognosis might safely be given Unfortunately, such is not always the case, and a guarded prognosis must be made because as in curcinomy, the de-preof malignancy of the growth and its individual resistance to irradiation, cannot be accurately estimated. In general, the round and spindle-celled types are more favorably influenced than are tho esteosarcomata and choundrosarcomata a fact easily un derstood in view of the difference in the histological structure the latter being composed largely of connective tissue. Surcomos of the skin and lymphatic glands is usually amenable to irradiation. That of the long bones even when recurrent after operation will frequently 'fade away' under this form of treatment.

When the growth is in the meditatinum marked relief of the symptoms and a temporary arrest of the condition or even a regression in the size of the tumor, may often be obtained

As in carenooma, it is advanable if possible to remove the growth suggradly Postoperative irradiation should always be employed Preoperative use of the X-ray is advocated and when such a procedure is followed if there is marked improvement in the clinical picture, and regression in the size of the tumor, it may be advisable to continue this form of treatment and postpone operative intercreeace, the decision in this repect resting with the surgeon. At all times the closest coopere tion between the surgeon and the radiotheropoutist is esential to the welfare of the natient

Technic - This is practically the same as that employed in the treat

ment of the preceding condition

Uterms Fibroids—Excepting the pedimenlated type and those in which the growth is at or above, the level of the unbiliness uterine fibroids can confidently be expected to disappear or markedly diminish in size under X ray treatment. The reduction in the size of the tumor becomes noticeable after the cound sometimes after the first treatment, and con times except for temporary enlargement during menstruation, until the mass can no loncer be detected.

The menorrhagra usually accompanying a fibroid is as a rule controlled after the first treatment, although in some cises the flow will show a temporary increase. Premature menopanse is caused which will be permanent if sufficient reduction has been administered but menstrual too will be restablished in from six months to two vears if less than a sterilizing dose has been given. With the resumption of the menstrual reput the fibroid may again culturge. For this reason the patient should be kent under observation.

Technic — Using a 9 inch gap 5 milliamperes at 10 inch distance and filtering through 3 millimeters of aluminum 7 to 8 minutes exposure

Technic — The method of treatment will differ according to the type of radiation used, that is, whether the older 110,000 volt machine or the newer 200,000 volt type is employed

Using the older method, the portals of entry for the ray are smaller in size, but more areas are irridated. The section of the body in which the tumor is located is divided into small area, 5 h 8 centimeters to 10 by 19 centimeters (2 by 3 inches to 4 by 5 inches), a border of ½ to ½ much being left between the area to prevent overlypping. These areas insully include the entire circumference of the body. Lead, or other smithle protective material, is so placed that the X-ray can reach only its area to be irridated. These points are then exposed in rotation to a maximum suberythem affiltered exposure, the ray long directed through early portal toward the lesson, thus producing a cross fire effect, which could be maximum amount of ray to reach the tumor without cuising destruction of the superficial tissues. The operator must be a irried against too much cross firing, as it is possible to produce a deep-stated necross without any apprient radiodermatitis.

The length of exposure of evel area must vary with the factors used (spark gap, milliamperage, distance, filter), but not over 2 to 2½ filtered musts (four fifths of on erythema exposure) should be given. Thus, using a 9 unch gap 5 milliamperes, 20 custimeters' (10 inches) distunce 9 milliamperes of aluminum (filter), 7½ to 10 minutes' treatment can be given to each area.

The number of areas irradiated at each session will vary with the total number of portals to be exposed, and with the condition of the putternt. Four to six areas are usually well borne, and sometimes more may be tolerated. Wherever it is possible the total number of portal should receive treatment within a week's time, oxpositive being made on

alternate days

This procedure is repeated every four to five weeks for three series, and aguin eight weeks after the third course of treatment. If procress has been satisfactory, radiation is discontinued, but the patient is kept under observation for one or two years, and at the first unfavorable indication, treatments are resumed

Too long-continued treatments will lead to atrophy of the submit usons tissues, telanguectasia, and even necrosis, so that, except in those cases where the gravity of the situation demands heroic measures, too many series should not be given

In employing the 200,000 volt technic, r "depth dose" of 110 per cent of an erythema exposure is administered to the growth. The number and size of portals used, and the amount of exposure given to each, varies with the location of the tumor.

Sarcoma —The estimated "lethal dose" when the 200 000 volt technic is used is 70 per cent to 80 per cent of the crythemi exposure, this in

contrast to the 110 per cent needed to destrow carcinoma. Therefore it would seem that a cure of this condition by X radiation should be easy and certain and that the most hopeful prognosis might safely be given Unfortunately, such is not always the case and a guarded prognosis must be made, because, as in carcinoma, tho degree of multipanser of the growth and its individual resistance to irradiation cannot be accurately estimated. In general, the round and spindle-celled types are more favorably influenced than are the octoastroomats and chondrosvicomats a fact easily un derstood in view of the difference in the histological structure, the latter being composed largely of connective tissue. Sarcoma of the skin and imphate glunds is usually amenable to irradiation. That of the long bones even when recurrent after operation will frequently 'fade away under this form of treatment.

When the growth is in the mediastinum, marked relief of the symptoms and a temporary arrest of the condition or even a regression in the size of the tumor, may often be obtained

As in carenoma, it is advisable, if possible, to remove the growth surgically Postoperative irradiation should always be employed. Preoperative use of the V-ray is advecated and when such a procedure is followed if there is marked improvement in the clinical picture, and regression in the size of the tumor, it may be advisable to continue this form of treatment and postpone operative interference, the decision in this respect resting with the surgeon. At all times the closest coopera ton between the surgeon and the radiother-peutist is essential to the welfare of the patient.

Technic -This is practically the same as that employed in the treat

ment of the preceding condition

Uterne Fibroids—Excepting the pediusculated type, and thoe in which the growth is at or above the level of the unbiliness uterine fibroids can confidently be expected to disappear or markedly diminish in 120 under X ray treatment. The reduction in the size of the timor becomes noticeable after the second, sometimes effect the first treatment, and continues, except for temporary enlargement during menstruation, until the mass can no longer be detected.

The menorrhagia usually accompunying a fibroid is as a rule controlled after the first treatment, although in some cases the flow will show a temporary increase. Premature measurement and the sufficient radiation has been administered but mentrons turn will be restablished in from ast months to two vears if less than a terilizing dose has been given. With the resumption of the menstrual epoch the fibroid may again enlarge. For this reason the patient should be kept under observation.

Technic - Using v 9 inch gap, 5 milliamperes at 10 inch distance and filtering through 9 milliameters of aluminum, 7 to 8 minutes exposure

Technic —The method of treatment will differ according to the type of dration used that is, whether the older 110,000 volt machine or the newer 200,000 volt tipe is employed.

Using the older method, the portals of entry for the ray are smiller in size, but more areas are irriduted. The section of the body in which the timor is located as divided into small areas, 5 h.8 centimeters to 10 by 12 centimeters (2 by 3 inches to 4 by 5 inches), a border of 1/ to 3/ inch bung left between the array to prevent overlappin. These areas insually unchange the entire circumference of the hody. Leid or other smitable protective material, is so pliced that the \$\Delta\$ rise cut reich only the area to be irriduted. These portals are then exposed in rotition to a miximum suberithems filtered exposure the risk king, directed through each portal toward the lesson, thus producing a crossian effect, which canables the maximum amount of risk to risk the tumor without cusing destruction of the superficial tissues. The operator must be wined against too much cross firing, as it is possible to produce a deep-sented necross without any apprient randoedermiths.

The length of exposure of each area must viry with the factors u ed (spark gap, milliamperage, distance, filter), but not over 2 to 2½ filtered units (four fifths of an ervthema exposure) should be given Thus, using a 9 inch gap 5 milliamperes 25 centimeters' (10 inches) distance, 3 millimeters of diaminum (filter), 7½ to 10 minutes tradition to the

given to each area

The number of areas arradiated at each session will vary with the total number of portals to be exposed and with the condition of the partient. Four to six areas are u utility well borne, and sometimes morninary be tolerated. Wherever it is possible the total number of portals should receive treatment within a week's time, exposures being made on elements discovered the second of the second

This procedure is repeated every four to five weeks for three series and again eight weeks after the flurd course of treatment. If progress has been satisfactory, radiation is discontinued, but the pitient is kept under ohe ryation for one or two year, and at the first infavorible indi

eation, treatments are resumed

Too long-continued treatments will lead to atrophy of the subent unions tissues, telangrectavia, and even necrosis so that, ever pt in those caus where the gravity of the situation demands heroic measures, too many series should not be given

In employing the 200 000 volt technic, a "depth dose" of 110 per cent of an ervthema exposure is administered to the growth. The number and size of portals used, and the amount of exposure piven to each, varies with the location of the tumor.

Sarcoma —The estimated lethal dose, when the 200 000 volt technic is used is 70 per cent to 80 per cent of the excitence exposure, this in

the ray, although some operators advocate their exposure, cluming that more immediate results are obtained. Six to ten series are usually sufficient to overcome the condition

For expo in, the perincal area the kneechest position is assumed with the has constructed a special chur having the tube under the seat which greatly facilitates this treatment and is more comfortable for the patient. Ty has technic only the perincul area is exposed treatments being given each week.

Tonsils—Finlarged tonsils of the infected type are benefited by N ray treatment, their size being reduced to normal, the hypertrophical lymphoid tissue being destroyed, and the pies reviewated from all the crysts. Cultures made from them after completion of the treatment are expectedly sterile, and the systemic diseases produced by infection from the diseased tonsils are regely improved, or cured.

The effect of the ry; is on the diseased lymphoid elements which are destroyed and replaced by connective tissue. The contraction of the connective tissue of the content of the best of the connective tissue of the connective tissue of the connective tissue of the connective tissue fibers expresses the pas from the tonal. This being the case, no benefit results when radiation is applied to tonals already filtration.

Usually six to eight treatments are given at biweekly intervals
sistemic condition as well as the recurrent sore-threats of which these
patients usually complains, shows improvement after the second or third
treatment the reduction in size of the tonsils becomes approven after the
fourth to sixth treatment. The shrunking continues after treatment has
been completed and it is not until after ary months that they neach their

ultimate size

Oceasionally it happens toward the end of, or even after, the series
that a white, glistening area will appear on the tonsil laving the appear
ance of an absce s or patch. This is due to the accumulation of pus in a
buried crypt which the contracting come tive tissue is unable to express
through the covering membrane.

If left done such alseesses will eventually rupture but it seems ad visible to incise them in order to rid the economy more quickly of the infected material

The objections to this form of treatment for tonsils, as advanced by the profession at large, are many and various, but are not substantisted by facts

Danger to Thyroid Submaxillary and Parotid Glands—Sometimes a treatment will be followed within twenty four hours by druness of the throat and fauces which persents from a few hours to a day. This condition is not permanent, and there has not been reported a single case properly treated that has sufficed more than a very temporary diminution in the action of the glands

If the thyroid and peroted glands are of normal size, they will not

is given to each of four areas anterior, two over the uterus and one over each ovary, and on the second day following, to each of three corresponding areas posterior Treatment is repeated every four weeks
With the 200,000 volt machine, a 35 per cent to 50 per cent crythema

do c 18 given Two portals, approximately 12 centimeters square (5 melics), are utilized, one on each side of the median line anterior

Menorrhagia -As in the above condition, the results of X ry treat ment are uniformly sitisfactory. The same technic is employed, and, as a rule, three or four series are sufficient.

The age of the patient is a very important consideration. If the time of the menopulse is near, hastening it need cause no concern, but in younger women, particularly where there is a desire to bear children, it is advisable, if conditions permit to give only sufficient ridiation to stop the excessive flow without emism, a disappearance of the menstrual crock No definite or fixed rule can be advanced as a guide for the mun

ber of treatments necessary to accomplish this result. Generally, how ever, after two successive menstructions have been missed, treatment may be discontinued, but the patient should be kept under observation for sec er il months Treatments may be resumed if indications warrant

Chronic Mastitis and Fibromata of Breast -In chronic mastitis the pain and tenderness are quickly relieved, and the induration disappears Fibromata gradually diminish in size, and after two to four treatments can no longer be detected

The breast may be divided into from two to four small areas or the entire gland exposed through one portal, according to its size, and the extent of the involvement. Using a 9 inch gap, 5 inilliamperes, 10 inch distance, 2 to 3 millimeters of aluminum filter, two fifths to four fifths of an crythem; exposure is administered to each area every four weeks

Prostatic Hypertrophy -The early relief from the frequency of urmation afforded by the use of X ray, recommends its use, especially in those cases which are poor surgical risks. The residual urine is quickly eliminated, and the patient is enabled to sleep through the night without di comfort. The general health, which in these cases is so undermined by the lowered function of the kidneys improves rapidly enlargement of the prostate is the result of calcareous or fibrotic changes, no benefit will result from radiation, but the adenomatous type will respond and uniformly good results will be obtained

Technic -Three are as are arradiated, two of which are situated an teriorly just above, and to either side of, the symphysis pubes the third includes the entire permittim. Using a 9 inch spark grap, 5 milliamperes 10 inch distance, and a filter of 4 millimeters of aluminium, an exposure of four mimites is given every week as follows The two anterior areas are irradiated at the first treatment, one week later the perineal area is exposed It is advisable to protect the testes from the direct action of

Position of Tube —The tube must be so placed that the central ray will strike the toroid at right angles. This is most important

Exposure — Using a Timeh gap o milinamper, 5, 10 inch distance 3 milinamets sof aluminum a three cold one-half minute exposure is given to eich tonal every two needs for extor eight treatments. In cases where adenoids are expectable to be affected a third area at the occupant is radiated every other treatment.

Cases are occasionally encountered in which translation every other work is impracticable. Under such translations the shore method must be altered and awing an 8 meh gip; milli imperes 10-meh distance and a filter of 3 millimeters of administration exposure of five munites to each tossil as mide even; her weeks for two or three treatments. This increased amount of exposure may be followed within twents four hours but needed not of the pharmar which will be larging to the patient unless he has previously been advised of the possibility of such a reaction and searned that it will be translatory, and not serious

Hyperthyroidism — To the evoy hith these genter is in most cases citred or markedly benefited by radiother my. The evision and colloidal thiroid are not amenable to this form of theraps, since there is no glandular

hypertrophy, and no toxicosis

In conjunction with X ray treatment frequent tests of the patient about microbolum should be mide as it is the only ab olute induction of the degree of toxicity, and consequently the only accurate guide for the frequency and number of treatments. When this test reaches + 10 or if the rate shous a ripid drop between tests treatment should be discontinued but the patient should be kept under observation for a very or two and radiation resumed if tone symptoms reappear or the rate of basel metabolism shows an increase

The first improvement noted is a decrete the normousness reduction of pulse rate and diminution of fremer. It about the same time the patient begins to sleep better and there is less sweating. The basal botabolism insually shows a slight decrease but occasionally it will remain at its high level for some time after the clinical picture indicates

improvement. A gain in weight is usually noted early

The gotter is usually but not always reduced in size sometimes disappearing alto, ether. The couplidadiums is the last and clear affected simptim. Frequently there is no change but as mattron improves and emicration disappears the prominence of the exchalla becomes less noticeable.

If treatment is carried too far my vedema will result and it is in order to avoid this unfortunate sequel that it is advisable to have a metabolism test made before each treatment. Who is shaddling the isthmus and thus protecting it from the effects of the ray the danger of hypomolism is rerult lessued.

project into the field of exposure, provided the shielding is properly placed.

Danger to Pitutary Gland—This gland is protected from the direct action of the ray by lead shielding around the area radiated, and consequently exposed by injured.

Danger to Nkm and Hair—With proper shielding and technic, used ficient radiation is applied to cause my damage to the integument or its

appendages

tective.

Questionable Results — It is true that some cases have not responded satisfactorily to irradiation, but such failures are due either to failly technic or to unproper selection of cases. Nor are 100 per cut perfect result claimed by the advocates of this method, and there is no other form of tonal therapy, not excepting surgery, where 100 per cent cures are obtained.

Length of Time —This is a valid objection to this form of treatment, and, in cases where infinediate elimination of the affected focus is essential, other measure—should be employed

On the other hand, the benefit from the treatment is seen relatively early, and in most cases the actual time lost is small. The advantages of this form of treatment may be briefly summed up as follows

- 1 Elimination of danger of death from anesthesia and postoperative hemorrhage
- 2 Avoidance of the possibility of lining abscess following tonsilled tomy
- 3 In cases where surgery is contraindicated as in diabetic, hemo philic, and cardiac conditions this method offers a safe and almost certain means of eliminating tons llar focal infection
- 4 By this method of treatt ent not only the tonsils but the peritonsillar tissue and pharyngeal ader ords are benefited

Technic—Position—The patient assumes the prone position, head turned to the side, resting on the car, and slightly lowered to inerest et distance of the angle of the paw firm the need. The chin is tilted upward further to increase this distance. Thus we have a site bounded by the ramus of the jaw anteriorly, the auterior border of the sterno-cleromastoid muscle posteriorly and the level of the tip of the mastend process superiorly, through which the ray will pies, not only to the tonsil, but to the pertinosillar tissue and the pharypageal vaulit.

Shielding—An opening 2½ by 3½ nuches is made in a sheet of lead foil at least 3/16 inch thick. This is so placed that the up of the mastoid process projects slightly into the opening at the center of the upper margin. The anterior border is slightly anterior to the posterior border of the ramis of the jaw. The head, face, and shoulders are covered with lead pro

of reasonably good health. It has been observed by some authors that the eves responding most rapidly to X rs, therapy are more prone to early neutrence, and in these the prognosis is least favorable. The first evidence of improvement is a diminution in the size of the

The first evidence of improvement is a distinution in the size of the glauds. This frequently occurs vers soon fifer the first treatment has been administered. Cou_h, disputa and other indications of mediastical pressure if present are the next to be reheved. The discoloration of the skin is usually the last symptom to show unprovement.

Technic—Some operators prefix to expose only the areas in which there is a lindular enlargement giving two fiths to three-fifths of a filtered retiliena exposure every four weeks. There are certain advantages in this method particularly where it is necessary for patients to travel a consider able distance for tre tinear and the fatigue of travel makes frequent trip-madisable. The best result have been obtained by dividing the triuk into twelve areas three areas on each said of the class and vidomen and three on each side of the hash and exposing three areas every third or fourth div to one-fifth of an erythema exposure. By this method the anterior areas are exposed once every two weeks. It has not been found thus we weak area is exposed once every two weeks. It has not been found at these lowers are the entered glends themselves and it has been noted that those lympostical the areas reducted show the same dimension in size as do tho e within

Using a 9 inch gap o milliamperes 10 inch di tance with filter of 3 milliameters of aluminum two and one half minutes exposure is given to

Freatment must be administered regularly and continued except for an oreasonal rest until the eliment picture is normal. Subsequently the pittint must be kept inder observation, and treatment resumed at the first evidence of resurrence of symptoms. With each recurrence the difficulty of controlling, the disease may be increased, and the length of time between recurrences gridually diminishes until the patient finally succembs.

Leukema — As in the preceding condition the leukemus are chronic, recurrent diseases whose termination is always fatal but the progress of the disea e may be temporarily arrested, and from a few mouths to two vers of comfort and activity added to the life of the patient by radio therapy. One case has been reported in which the patient lived seven years.

The white cell count is the guide for the amount of ridiition and number of treatments no radiation being given after the count reaches 1,0000

Technic—The treatment is usually directed to the pleen and long bones, one-twelfth to one-cighth of an erithema expo are being given to each area every two weeks. The spleen is divided into twelve areas four

The thymus is very frequently involved in hyperthyroidism. Con sequently it is enstomary with most operators to expose it at each treatment. In many cases, instead of exposing the thymus, an area on the hack of the neck, extending from about the fourth cervical to the second dorsal vertehra may be irriduated. Results from this method have been equally satisfactory, the effect probably being due to the action of the ray on the sympathetic nervous system. Before X-ray treatment is in stituted, it is advisable that a careful eximination of the patient be made to eliminate the possibility of a foest infection or other underlying could thou which may be the causative factor, for no benefit will result from irradiation until such source of infection has been removed.

It is a common belief that following X ray treatment of the thyroid there occurs extensive formation of connective tissue around the glad, which increases to a marked degree the difficult of subsequent operation, if such procedure is necessary. This contention is without substantiation, by both experimental findings and the experience of the majority of operators

In case of hyperthyroidism associated with menstrial disorders, no benefit may be obtained from irradiation of the gland. With such patients, radiation amplied to the overices will frequently correct both the

menstrual and thyroid trouble

Technic — Usin, an 8 inch gap, 5 milhamperes, 10 inch distance, and filtering through 3 millimeters of aluminum, 3 to 5 minutes' exposure is given to each lobe of the thyroid and to one area over the thruss (or back of neck) every two or three weeks for three or four treatments. If after the fourth treatment, there is no improvement, the case is regarded as misuitable for this form of therapy, but if the clinical picture shows satisfactory progress, treatments are again resumed after two months, and a second series of three or four treatments is given. It has sometimes been found necessary to repeat these series several times, some cases having required as long as two and one-half years to cure, but insually a New orders is sufficient.

car or less is sufficient
When irradiating the ovaries, one-fifth of an erythema exposure should

be administered to each or irs

In patients whose toxicosis is extreme where collapse is imminent, X ray is contra indicated its administration being sometimes followed by death—Such cases should be treated by other measures in an effort to

improve the patient's condition sufficiently to permit radiation

Hodgkin's Disease—Although X ray therepy will not permanently eure Hodgkin's disease it will so ameliorate the symptoms reduce the size of the glands, and improve the general condition, that mouths, or even years of comfortable and active life may be afforded the patient. In cases with the most unraisorable prognosis, patients have, as a result of treat ment, been able to return to their usual occupations and the enjoyment

piere acid or simple alcohol preparation, the aspiration of the e glands may be uccomplished without interference with X ray therapy. The in usion usually heals rapidly but if difficulty of closure is experienced, a single exposure of the area to nuffiltered radiation will in most cases hatten recovery.

Improvement is first noted in the lessening of the pun in the glands, later in a reduction in their size. They become firmer, and eventually entirely disappear, or, when calcification takes place, only a small stone-

like nodule remains

Technic—Various operators use different thicknesses of filter from 1 to 5 millimeters of alimmunin being advocated. No material advantage has been observed in any defamite thickness of filter but it has been the authors custom to use 1 or 3 millimeters of alimmunin and with as bind, jag, 5 milliampters at 10 met distince to give an exposure of from two to four minutes overs three weeks. Better results have been obtained by dividing the neck into small areas and exposing each area to this amount of radiation than by exposing a single area melading the one entire side of the neck. Exposin, the opposite side of the neck for the briefft of cross fire is advanta, come

Using the 200,000 volt technic, a one-third ervihema dose is admin

istered once overy three weeks

Tuberoulous Peritonitis.—The benefit obtained from Nav therapy is remarkable in this condition, improvement being noted ulmost immediately after treatment is beguin. The addonen is divided into four areas, corresponding to the quadrants and each week one-fifth of a filtered erithema eryosure is administered to each of two areas.

Tuberculous Ostomyelits—Vriv treatment of this condition frequently proces beneficial. One fifth of an crythema exposure ever two or three weeks insually produces more satisfactory results than more in tensive radiation less frequently administered. The discharging sinuses soon heal and the progress of the discess is arrested, but regeneration of

the bone is not to be expected

Fulmonary Tuberculosis — Mithough a great deal of investigative work with \text{Ymy} has been conducted in an effort to combut this disease the results have not been uniform or, in must cases even satisfactor. Some patients have benefited greatly by this form of therapy which has many strong advocates. The consenses of opinion is that fractional exposures are superior to massive two areas anterior and two areas posterior being exposed to one tenth to one-fifth of a filtered erathema dose, every other week.

Sinustis and Mastoiditis—The use of \ ray in the treatment of acute and subcente sinusitis and inastoiditis is coming into greater prominence as the benefit derived from its admin tration are more widely appreciated. Cases characterized by pain over the affected cells and a constant

anterior, four lateral, and four posterior, four of which are exposed as follows: On the first day one area on the anterior and one on the posterior surface of each arm, and of each forearm is exposed. On the third day three areas on the anterior surface of each arm, and of each forearm is exposed. On the third day three areas on the anterior surface of each leg and thigh, and on the fifth day corresponding areas on the posterior surface are irraduated.

It has been observed that a continuance of treatment for a prolonged period sometimes results in the establishment of an apparent immunity of the patient to X ray. In such eases, it has been noted that a complete change in the method of administration was immediately followed by improvement. Once as of this kind was treated according to the above method for several months. The white blood count, originally 230,000, was reduced to 40,000, but could not be further lowered. By changing the technic and using that outlined for Hodgkins discusse, ax cepting that smaller amounts of radiation were administered, the count was quickly lowered to 10,000.

Using 5 mich gap, 5 milhamperes, 10 mich distance, and 3 millimeters aluminum filter from one to two minutes exposure is given to each area

Bantis Disease—In the limited number of cases of Bantis at each than been subjected to X viv therapy, the reports indicate favor able results, with reduction in the size of the splicin and improvement in the general condition of the patient. The splicin is inserer reduced to normal size, which is easily understood in ties of the pathological changes in this condition, as the organ is already undergoing fibrous degeneration. The greatest reduction in size reported is about 50 per cent. This rule of course, is soily tempority, and cure cannot be expected.

Technic -Radiation is directed to the splicin, which is divided into small areas, so exposed that each will receive one-tenth of a filtered

erythema exposure every weck

Tuberculous Adentus — Drappearence, or marked diminution in size, at subsequent calcification of the glands, can confidently be expected in ubercular adentus. However, treatments must be continued at regular intervals and for a sufficient length of time. Indeed, the only difficulty in the conduct of this condition is the length of time involved, which is discouraging to the patient and causes him to seek other measures of treat ment producing more immediate results.

The more recent the condition the more rapid the response. The firmer the glands the more revalls they are influenced by the ray. Some cases require only four to five treatments, while others will require a year or more before all glands disappear or calcify. Glands which have broken down, or in which fluctuation is noted, should be increed and free draining established before irradiation, otherwise the puss will eventually break through the skin, and more extensive scarring result. By 1 sing

### CHAPTER XV

#### ORGANOTHERAPEUTICS

# A. J CARLSON

# INTRODUCTION

Definition—The term organother typ may be defined as the success ful control of the disease syndrome due to the hypofunction of an organ by administration of the organ itself or of substances prepared from this organ. Other terms, sometimes employed synonymously with organo therapy, see opotherapy, southerapy histotherapy sequaretotherapy,

hormone therapy etc

The sbove definition strictly evoludes organ transplantation as a part of granular g

Organ Transplantation —There is a much wider range of possibilities in organic transplantation than in organic terripy. When phywology and surgers shall have advanced to a point where an organ has the kidney can be transplanted as a perminent sub titute for a diseased kidney, no one doubts that the symptoms of nephrits due to the diseased kidney will be permanently controlled. But no amount of advance of chemistry and bology will ever enable us to cure uremit due to kidney, disease by the

administration of kidney extracts
It is or ought to be exident that

It is or ought to be evident that organs like the liver the lings and the kidnes which through the action of their living cells runove customers from the blood, control the chemical equilibrium and the metabolism of the body not through substances tored up in the cells and given off to the body fluids but through proce seed pendent upon their living functure. The control of deficiency of this type of organs by administration of organ debris or organ products is as futile as the attempt to re-

out, radiotherapy, from the standpoint of technic divides itself into two branches, that is, superficial or unfiltered treatment, indicated in the majority of dermatological conditions, and deep or filtered therapy, in diented in conditions involving the deeper tissues A4 stated, only the more important diseases have been discussed. There are many other conditions which respond favorably to the ray, such as verruea, cillosity, syringoma, serofuloderma, erythema induritum, furunculosis, etc. For a detailed study of the A ray in connection with skin discuses, the author recommends the book entitled I ray and Radium Treatment of the Shin by Dr George M Mackee, which is doubtless the leading work on that subject

A ray must not be regarded in the light of a panacea or cure-all. In many cases it does not cure at all, but merely inhibits the pathological cells, allowing the normal body forces to perform their normal functions, and sometimes merely affording relief. In some conditions X ray alone will effect a cure In others it is only a valuable adjunct to other forms of treatment. In many cases X ray is tried as a last resort, when other measures have failed Too quick and too brilliant results must therefore not be expected, but time must be allowed, and this form of treat ment regarded with the same tolerance as other forms of therapy must also be remembered that in certain diseases no hard and fast rules for treatment can be laid down, but each ease must be treated as an in dividual one. In such instances it is impossible to give a sitisfactory prognosis

Generally speaking, the X ray has an unhimited field of usefulness in medicino and is one of the most valuable therapeutic agents which mod ern seience has to offer Its success, however, depends upon careful ding nosis, the proper selection of cases, a thorough and well mastered technic, and a close cooperation between the physician or surgeon and the ridio therapeutist Finally, while at the present time X ray therapy has its limitations and must not be regarded as a panacea yet its scope of nee fulness is constantly increasing, and, with a better understanding of its value and a closer professional cooperation, it presents unlimited pos sibilities for the future

The use of animal extracts in medicine is referred to in the Papyrus Ebers one of the oldisk minuscripts in the history of medicine. Organs or organ extract of animals had a place in the medical superstitions of the anicent Hindais and in the therapy of Hippocrates Dioscorides and Galen. The naive empiricism of the organotherapy of the early Greek physicians was not improved upon by the physicians of the Middle Ages. We find that the larer of the pigeon and the walf was recommended for epideps, extract of human heart and the brain of the rabbit for epideps, extract of human brain for delulity the lung of the fox for dispute rennet for gastric disorders the testicles of the donkey and the stag for depressed as x functions, etc.

It would seem that the use of extracts of lung liver ladnes, etc, to care hypfunctioning of these organs presupposes complete ignorance of the physiology of these organs. How much unne will be exerted by a duel and powdered kidney or how is it possible for a lung extract to send oxygr into and to take eithor dound out of the blood! But liver kidney brain etc, in powder form tablets, or solution are on the market today as therapentic numelus. Studying the lists of organitherapent preparations on the market today all elaming support from clinical results one gains the impression that some of our drug munifacturers are guided by the medical superstitions of the Orient, and by medieval medical lore rather than by the modern sciences of physiology pharmacology and pathology

The hundreds of glandular products listed in trade journals include brain spinal cord, liver, lun, bronchiol gland lumph glands spicen carotid gland muscle leukostes, blood bone marrow etc. They do not differ greatly from the lists of a cultury or two ago, the chief difference is that the 'indications are expressed in more modern but none the less obscure phraseology. The therapeutue use of many of the conjunt preparations by the physicians of to-day is a di-couraging instance of therapeutue flatium.

The older or, motherapy was based on the labst that it was possible to influence a diseased or, in by the administration of the same but bredith orgun from animals modern organotherapeuties is concerned primarily not with the condition of the organ diserved but with the activities of other organs which are imprired by the absence or dimministon of an internal secretion of the diseased organ. Thus divised is not given primarily for its effect upon various other organs whose activities are in part dependent upon the internal erection of the thyroid.

Recent experimental and climical work in this field has accordingly been directed to two chirf aims (1) the demonstration that various or ans produce internal ecertions and (2) attempts to determine the conditions under which these may be utilized for therapeutic purposes

p iir the effects of a broken wheel in the machinery of a watch by pouring into the watch case a powdered watch wheel A whole wheel and nothing else will start the watch machinery going But in actual practice, at present, there is not a shirp distinction between organotheraps and organ transplantation, at least as regards some of the endocrine glands It is a fact that transplantation of a thiroid or an overy from one person to another has so far been only a temporary success. The triusplanted orgin undergoes atrophy or lists and absorption, somer or later, that is, heterotransplantation of any of the glands of internal secretion amounts to little more than the subcutaneous or intramuscular administration of the extracts of these organs. The surgery of hetero limited life of the graft are partly known but there is little hope that the modification of individuality within the species neces are to render the transplant perm ment will be an accomplishment of to morrow

The continued study of the chemistry and biological reactions of ex tructs of animal organs will gradually reveal substances having specific and useful drug actions not related to the living role of the organ in the intact animal At present we have two such substinces in epinephrin and pituitrin When epinephrin is used in medicino as a local styptic or in bronchial asthma and pituitrin to induce uterine contractions, these are as distinctly drug actions as the use of digitalis to stimulate the heart or atropin to dry up the secretions. No one supposes that the physicological actions of the latter alkaloids in the animal body bear any relation to the role of these alkaloids in the plants which produce them. The hypophysis antedates the uterus in animal evolution by myrides of ages, and, so far as we know, the mammalian male has the same kind of hypophysis as the female. If the term organotherapy is to include the distinctly drug actions and uses of animal substances, it seems uc ought to speak of the useful actions of vegetable alkaloids as plant organotherapy On the other hand it is being recognized that some of the effects of

well known drugs may be due to specific actions upon organs of internal secretion Some of the effects of iodin for example, may be due to the feet that it increases the amount or potency of the internal secretion of the thyroid. There is exidence that certain foods also increase the activity of some organs of internal secretion

The definition includes the successful use of digestive enzymes in the control of the disorders of digestion following hypofunction of the digestive glands But as commonly understood, organotherapy is limited to the use of specific substances or hormones from the organs of internal secretion

History—Empirical organotherapy or the attempt to control symptoms of organ discuss by feeding the patient the healthy organs of animals, is one of the oldest forms of therapeutics

but other important liver function, such as glycogen storage protein deamidization, synthesis of urea from ammount distinction of fats bile formation, etc, cannot be curried out by liver extracts. The futility of brain extract therapy in the case of defects or destructive lesions of the nervous tissue—equally apparent

The only possibility for organotherapy in the case of the tissues just referred to is the chance or endence that these tissues contain substances capable of stimulating the impaired organ or organs to increased activity. For example, the kidnes may contain a substance that stimulates the living ladins cells to increased secretors activity although the substance their cannot secrete urine. It is supposed for example that the main mary glands contain galactagogue substances. Substances may be prepared from the gastric increase that induce secretion of gastric pince when in jected into the blood. The living contains a cholagogue in so far as it contains blue elements. Nervous tissue is rich in lecthin and some livined that administration of lecthin is favorable for the growth and metaboli in of nervous it sue, etc.

The extitution of such spreific organotropic substances in these various organs must first be demonstrated by accurate laborators experiments be fore one is justified in a image such organ extracts on patients where even under the best of conditions all the factors cumot be controlled. The undestriminate use of issues extracts is unablades of unhanoun or complex or, in leads to confusion. At least one can place little credence on the results of such clinical use of organ extracts until supported by laboratory experiments or animals. This principle must be imisted on all the more since, many of the clinical leasons of the kidneys lungs liver and brain can be reproduced experimentally in numbers.

A typical case in point is the testicular 'permin' of Poehl, which was produmed as a general metabolic stimulant, and for a time used as

a cure-all by a few uncritical enthusiasts

Frimary Hyperfunction Not Altered by Organotherapy—There is the or no hope for successful or, motherapy in diseases due or supposed to be due to a primary hyperfunction of organs. Where a milady is definitely traced to primary hyperfunction of an organs the remedy is surjected (direct or indirect), not medical. But the question of an ont and out organ hyperfunction melading scrious clinical disorders is at present a complex and uncertain chapter in medicine. Gastro hyper execution of hyperacidity is supposed to came extruit symptoms in gustric and due denal helers, and in a scalled vigotoma. The syndromes of toxic goiter, acromogal hemolytic junidae, and certuit types of anemia hyper guntalism and extendible in the hyperacity of the hyperacity of the hyporotype for the came of the came of the large with the came of the came of the came of the properties of the came of t

Great progress has been made in the former attempt, it has been shown that miny organs produce internal secretion essential to life, or essential to normal life. Much less progress has been made in the successful utilization of these internal secretions in discuss, and we are only beginning to be ablo to evaluant the curs of some of the fullin's.

The first step in retional organotherup; was taken by Broan Sequard in 1889, in his work on the physiological effects of extracts of the testicles. The work of this French physiological effects of extracts of the testicles. The work of this French physiologist was not well controlled, and his claims greatly evaggerated. Nevertheless, his theory that "all glinds, whether they have exerctory duets or not, secrete useful principles the absence of which is felt when these glinds are extriputed, or destroyed by disease," for shadowed the modern "hormone" physiology. Rational organical control of the symptoms of thivord hypofunctioning by the use of each control of the symptoms of thivord hypofunctioning by the use of thyroid extract through the work of Schiff, Reverdin, Locher, Fox, Mackenzic, Murray, and others. This brilliant achievement has had two effects on subsequent biological investi, ition and clinical practice. (1) it has been a potent stimulus in exhibiting, similar types of finition and methods of practical control for other organs of the ledy, (2) it has stimulated the clinical use of other organ preparations without definite physiological indications of their value and without experimental control

## GENERAL PRINCIPLES OF ORGANOTHERAPY

Hermone Substance Essential — Successful trainment of the symptoms of hypofunction of an organ by extracts of said organ requires that the essential function of the organ consists in producing a substance or substances in the nature of hormones

It follows as a uccessary corollary to this principle that organisher up is out of the question in the case of tissues in which the production and storage of such substructs are either absent on of no findamental importance in the function of the organ. Be lung tissue permits or produces the exchange of oxygen and cirbon droud between the blood and the air So far is we know the limit tissue does not store any substruct that cut in any way facilitate lung function or act as a substitute for the living lung. Hence, the certain futility of lung extract therapy of purumonia or influencing tuberculoss.

The same general situation exists in repard to the kidness the liver, the nerrous tissue, the heart and misseular tissue in general, and possibly other organs. No amount of flooding of the bods fluid with kidney extricts can separate the numeric constituents from the blood in the absence of hung kidney cells. The here plays a complex part in the bods, and part of its function may be the production of important hormones,

but other important liver functions, such as giveogan storage protein deamidization synthesis of uria from ammonia destination of fats, bile formation, etc. cumot be carried out by hier extracts. The futility of brain extract therapy in the case of defects or destructive lessons of the nervous treue. equally approximately.

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A typical case in point is the testicular spermin' of Poehl, which was proclauned as a general metabolic stimulant and for a time used as

a cure-all 'by a few uncritical enthusiasts

Finany Hyperfunction Not Altered by Organotherapy—There is little or no hope for successful organotherapy in diseases due or supposed to be due to a primary hyperfunction of organs. Where similarly is definitely traced to primary hyperfunction of organs, the remedy is surjusted of the organ hyperfunction, including scrious clinical disorders is at present a complex and uncertain chapter in medicine. Gistric hypersecretion or hypersecritic is supposed to crue exertain symptoms in gistric and due decal ulcers and uncertain clye along the hypersecritic supposed to crue exercise spardoms of toxic gotter, acromogal hemolytic jounders and certain types of noemia hyper sentialism and osteomalacia are held hy many scientists and clinicians to be crusted by hypersecritivity of the thyroid hypophysis splicen pineal body adrenal cortex and gonads respectively. If it shall be clearly established that sufficient hyperactivity of these and other glands of internal

Great progress has been made in the former attempt, it has been shown that many organs produce internal secretions essential to hife or essential to normal life. Much less progress has been made in the successful nithization of these internal secretions in disease, and we are only beginning to be able to explain the cause of some of the failures.

The first step in rational organotherapy was taken by Brown Sequard, in 1889, in his work on the physiological effects of extracts of the testicles. The work of this French physiologist was not well controlled, and his claims greatly exaggerated. Nevertheless, his theory that "all glands whether they have exercise useful principles, the absence of which is telt when these glands are extripated, or destroyed by disease," foreshadowed the modern "hormonic" physiology. Rational organotherapy was finally est blished in the eith inneties by the successful control of the symptoms of thyroid by pofunctioning by the use of thyroid extract through the work of Schiff, Reverdin, Kocher, Fox, Muckenze, Mirrar, and others. This brilliant achievement has had two effects on subsequent biological investigation and clinical practice. (1) it has been a potent stimulus in establishing similar types of function and methods of practical control for other organs for the book. (2) it has stimulated the clinical use of other organ preparations without definite physiological indications of their organ preparations without definite

#### GENERAL PRINCIPLES OF ORGANOTHERAPY

Hormone Substance Essential — Successful treatment of the symptoms of hypofunction of an organ by extracts of said organ requires that the essential function of the organ consists in producing a substance or substances in the nature of hormones

It follows as a necessary corollury to this principle that organotherapy is out of the question in the case of tissues in which the production and storage of such substants are either absent or of no fundamental importance in the function of the organ. The lung tissue permits or produces the exchange of oxygen and cirbon dioxid between the blood and the air so far is we know the line, issue does not store in substance that can in any way facilitate lung function or act as a substitute for the living lung. Hence, the certain faithful of lung extract therapy of pneumonia or pulmonary tuberculosis.

The same general situation exists in regard to the kidneys the liver, the nerrous tissue the heart and missell it issue in general, and possible other organs. No amount of flooding of the body fluid with kidney extrects can separate the urmary constituents from the blood in the absence of living kidney cells. The liver plays a complex part in the body, and part of its fluiction may be the production of important hormones,

of these substances are produced by the gland cells and are of equal importance in gastric function. The reason is evident. Pepsin is stored
up as pepsinogen in the resting cells while the hydrochloric acid is not
stored up but discharged from the cell as soon as formed. Hence a gastric
mucosa extract contains the former but not the latter and in organotheripy
of the gastric mucosa bydrochloric acid must be added from some other
source. Analogous conditions may obtain in some of the endocrine glands
to it is, therefore, important in determining to what extent the internal secretions are stored in the organs producing them and how much of them
is necessary to maintain bealth. This is possible in a giveral way in the
case of a few organs. Thus, from studies on the amount of thrond
which it is necessary to administer to maintain health in animals or man
suffering from removal or disea e of the thrond it is possible to form an
approximate estimate of how much thrond secretion is necessary and from
the weight of the gland how much material is stored in it. Such calcula
tions show that the normal thrond conturns sufficient secretion to meet
the demands of the body for several west.

From a determination of the vincent of epinephrin contained in the blood of the suprareal vein and from the rate of blood flow through the suprareal glands it is possible to mike a rong, he stimate of the amount of epinephrin produced dails. When the suprivinal glands, it is found that the latter is equal to the epinephrin output for only a few hours share some of the internal secretion is almost invariably lost or destroyed in the manipulations necessity to prepare the gland for administration, it is evident that the conditions in the case of the thyroid are far more favorable for success than in the case of the suprareals and the princers

In addition to knowing how much of the eccretion is stored in the gland, it is important to know how urg nt is the body's need for the secretion and how long the latter remains in the body. Light on these questions has been obtuined by determining how soon symptoms appear efter removal of the glands. Taking two extremes it his been found that symptoms may not appear for weeks or months after removal of the thyroid whereas they appear within four to eight hours after removal of the panereas and they may appear within a few hours after removal of the partity rowls or the adrenal cortex. It is evident that the clinices for successful organotherapy are much more favorable in the case of the throad gland.

Stability of Hormone —The physiologically important hormone stored in the gland must be sufficiently stable to resist the necessary chemical processes of making the gland extract, and for practical organicherapy the hormone must resist the action of the digestive enzymes and must be absorbed into the blood in active form.

This is probably the most serious limitation of organotherapy. All

secretion cause disease, the only type of organotherapy that may be of value is the administration of organ extracts that depress the hyperactive gland-if there are such extracts For example, it has been reported that administration of ovarian extract to young male animals retards the de velopment of the testes, and the observations of Lillie on the Freemartin cem to show that the testicular and ovarian secretions have some mutual inhibitory action on the development of the respective sex characters, at least in early embryonic life. This type of organotherapy is at present purely empirical, and should be well grounded by animal experiments before it is applied to patients. If the hyperactivity of a gland is a compensatory one, administration of extract of that gland may arrest the gland growth but will not control any other symptoms The 'hyperplasia' that may be induced in some endoerine glands by extirpation of other endocrine glands is no evidence that the extirpated glands secrete hormones holding the other glands in check. Hence, there is at present no experi mental basis for a pituitary organotherapy of toxic goiter. If the glandu lar hyperplasia and hyperactivity is primary, such organotherapy is clearly contra indicated

Dystrophy and Perverted Secretion —There are it present no definite indications for organotherapy in disease due or rather supposed to be due

to organ dvatrophs, that is, a perserted or pathogenic secretion

The theory of a perserted or pathogenic secretion as the cause of dis case has been advanced for some of the maladies related to the glands of internal accretion, notably the thyroid and hypophysis. The theory has little or no hasis in established fact. But assuming it is true, the fol lowing possibilities must be considered (1) The gland may yield both the normal and the pathogenic secretion. In that case the patient will show no symptoms of glandular bypo activity, the symptoms of the dis ease being solely due to the perverted secretion. In such a case specific organotherapy will in all probability prove uscless, as there is no reason for believing that the normal secretion of the gland will control the pathological secretion (2) In yielding the pathological secretion the gland may be so altered that the normal secretion is diminished or absent This is the most likely condition. In such a case the syndrome will be a compley of glandular hypo activity and pathogenic sceretion, and it is obvious that organotherapy may have a favorable effect on the hypoglandular symptoms but leave the pathogenic secretion symptoms unaffected

Accumulation of Hormones—The hormone or hormones must be stored up in active form, and in some quantity in the organ producing

them, for successful organotherapy of this organ

It is obvious that unless the specific hormone in question is stored in the gland to some extent, administration of the gland extrict in hypofication of the gland will be uscless. For example, a glycern extract of gastric mucosa contains pepsin, but no hydrochloric acid, although both

Hedon claims that when the blood from the panercatic vein is in troduced into the portal circulation of a diabetic animal there is a diminution of the glycoauria while it has no effect when introduced into the general circulation. Thus he concludes that it is necessary for the internal secretion of the panereas to reach the liver in order that it may be active. But Hedon's results are disputed by Carlson. In any event, it is a fact that the establishment of an Eck fistula in animals does not induce hyperglycemia and licosuri; on ordinary carbohydrate rations despite the fact that by this operation all the portal blood in cluding that from the paneress is sent into the general circulation before a small fraction of it reaches the liver by way of the hipatic artery Hedon's theory is untenable in view of this fact. But we have a classical example of such distant activation in tripsing and enterokinase. and the possibility of analogous conditions in the gland of internal secretion where all attempts to a clate or demonstrate active hormones have so far been failures must always be kept in mind and to ted

Standardization of Products -The hormous must be relatively table in the form in which the gland or gland extract is put on the mar ket for ther spentie or research purposes and the or an preparations must, so far as po sible be chemically and physiologically standardized

No argument is needed in defense of this principle, although it is not always complied with Stability of the hormones may not be attainable, in which case we must have recourse to fresh glands or fresh extracts. The only criticiam that may be legitimately directed against manufacturing concerns in such cases is for failure to indicate the date of preparation of and the rate of deterioration of the extract. While pancreatic secretin has so far proved to be of no therapeutic value it can be prepared in active form but not kept from rapid deterioration, so that the prepara tions on the market become mert in a few weeks. This would be serious in case the ictive secretin was of any value in curin, or controlling disease

The chemical and physiological standardization of such substances as thyroid pituitary and adrenal extracts or 'insulin is just as important as the standardization of diphtheria antitovin. It should be insisted on by the profession and required by law, in view of the fact that the prepara tions on the market may show great viritions in physiological activity This is obviously a great drawback to the successful use of these substances The standardization of insulin is imperative in view of the strious consequences of an overdose of this substance

The importance of chemical and physiological standardization of preparations of the parathyroid and the corpus liteum is equally obvious The parathyroids are very small organs distributed on and in the thyroids and in some case in the thymus. It takes a good deal of training and care to avoid the inclusion of small accessory thyroids or nodules of thymus in gathering fre h parathyroid material. There is some evidence

solution But, because of the necessity of continuous or daily admin istration, intravenous or hypodermic injections of extricts of the entire glands produce toxic effects, in some cases more acrious than the symptoms treated, owing to the presence of injurious tissue split products. The chemical manipulation necessary to remove these toxic by products in troduces greater chances for destruction or loss of the hormones them selves Moreover, intravenous or hypodermic injections must as a rule be done by a physician or a nurse, and even when this is done there are chances for local and general infections when employed daily or several times a day for months and veurs This is one of the difficulties of the insulin thereps of diabetes Practical organotherapy thus limits itself in most cases to administration of the gland or the gland extract by mouth That is, the hormone must run the gamut of enzyme action both in the lumen of the alimentary tract and in the wall of the absorbing intestine In view of this tact, the failures of or motherapy are less surprising to biologists than the striking success in the case of the thyroid. If the founders of thyroid organotherapy had known of the general completeness of the protein and fat hydrolysis in the digestive tract, we believe they would serreely have had courage to try the feeding of thy rold in my vedema

and erctinism Classical examples of destructive action of the digestive enzymes on hormones and alleged hormones, or failure of these hormones to reach the blood in ictive form when administered by mouth, are epinephrin pitu itrin insulin and the pancreatic and gastric secretins

Activity of Hormone — The hormone must be present in the gland in active form, be activated by the chemical processes of preparing the extract, or the normal activator added to the gland or the extract

The thyroid hormone, as well as epinephrin pitiutrin, 'insulin," are present in the glands in active forms or activated by the processes of extraction Whether any of the other internal secretions are stored as pro hormones and must be activated in or by the products of other organs has not yet been determined Munser assumes that all the endo erine glands work in pairs one activating or inhibiting the other. He therefore concludes that before an organ is used in organotherapy it must be 'activited by previously removing the inhibiting gland from the animal For example, before using the pancreas of an animal to con trol pancreatic diabetes in a patient, the animal must have had the an terior lobe of the hypophysis extirpated some time before the panereas is excised in order to yield an "activated" panereas. This fancish theories not borne out by the well established facts of thyroid organotherapy, and we shall point out later that extraption of some of the alleged in libitors of the adrenals do not influence the epinephrin content of the land

telligent cooperation of the climic and the laboratory will assure a quicker arrival at the truth

The Dangers in Organotherapy —When as in the case of the thiroid oral administration is effective, this method should be used exclusively as a routine procedure. There is danger in overdosing with thiroid extract even when given by mouth but all of the other endocrine preparations can be administered per os in large doses and for long periods with little or no deleterions effects. There may also be no evidence of beneficial effects, but that is another story of organithering.

Intravenous organotherapy is the most dangerous hypodermic and intransacilly administration is less dangerous than the intravenous route, but hypodermic injections of crude organ cytacts are capible of seriously injuring the patients through (1) snaphilaxis (2) toxic protain deriva trees (listamin, peptiones, etc.), (3) toxic lipoids (cholin neurin etc.) (4) local damage of tissues at the site of injection. Hence is a general principle, organ extracts of unlinous composition (and this includes all of them except thyroxic aderivations are called for Crude endocrine and insulin.) must not be given intravenously or hypodermically expectedly whin repeated administred introduce the additional danger of non-specific protein therapy. We must clearly recognize that intravenous or hypodermic therapy is always imphysiological and should be used only with pare products, and when the oral route yields no results, or too slow effects.

The principle laid down in this paragraph puts a serious task before the manufacturer of organotherapeutic products a task demanding the highest grade of scientific ability and complete integrity in fact a higher type of accuracy and integrity than that required in ordinary bonest

Early tereus Late Therapy in Endocrine Hypofunctions—The importance of early diagnosis and therapy of hypofunctions of the gloud of internal secretion is obvious since the early therapy may check further deterioration in the gland system primarily involved and prevent the development of non reversible atrophies or abnormalities in other organs. Early therapy may thus be effective while late treatment is less or even non-effective. But sex aplism and absence of adole cence due to hypothyrodism may, in some cases at least be corrected by thyroid organo therapy leginus as late is the thirtheth or fortheth year.

While we all subscribe to this principle the great difficulty comes in the application from the fact that none of the incipient symptoms of hypofunction of any endocrine system are specific. For example, the primary values of slight increase disturbances slight adiposity slight disturbances are in growth slight disturbances in ser functions, slight disturbances of variation in function of corpus luteum with the age of this temporary organ, and with the meidence of pregnance. Even the most careful main facturer, therefore, is facing great difficulties, since his only sources of material are the abattors and the only criterion of the time of orulation in the abuttor animals is the appearance of the overy by direct inspection. Dannereuther states that only one of the several drug firms who place ovarian products on the market would infirm that their corpus luteum preparations are made from the corpus luteum of pregnant animals. Here exists, at present, another serious source of error or cause of discripancies in therapeutic effects in the usual practice of removing fats of lipoids from the dired products or solutions of such organs as the ovar, the hypophysis, and the adrend corte. The solution that the remote the lipoids may also remote the hormones. Until the hormones have been actually isolated it would seem more promising to use the cutive gland, at least when given by mouth

Clinical Control in Use of Organ Extracts —In case of the endocrine glands in which organotherapy is still in the belunce the clinical use of organ extracts should be most rigidly controlled and should be preceded or paralleled by animal experiments

or paralleled by animal experiments

Empirical organicher pi) is not to be condemned entirely, but when organ extracts are used in this way without the guidance or positive in dications from physiology or pathology, medical progress demands that other factors be eliminated so far as possible, so that the results met have some meaning. A careful porusal of the hterature will convince any candid man that we are great sinners in this regard. The other factors we refer to are (1) other therapeuto measures such as changes in diet, occupation, environment, etc., simultaneously instituted, (2) the element of suggestion and (3) the natural history of the malady. For example, if we disregarded the natural course of colds, or mumps, or chord, we could readily establish a splendid organicherapy of these diseases. This is too obvious to mention, except for the fact that our literature demonstrates that it is so frequently forgotten. Our age has been characterized, medically, as one of their peutic militius. On the contrivy, in the field of internal glandular diseases and organicherapy it is an age of the trapeutic creduity and foolish faith in the biological and medical omnscience of drug manufacturers.

The ideal scientific control is not easily attained in most clinical cases. There are the spontaneous fluctuations in the severity of symptoms, spon taneous repur, irrespective of all therapp, and factors of general hygiene and nutrition which the good physician shwars endeavors to improve There are the uncertainties of diagnosis in all border line cases, sepecially in the so-called pluriglandular dreases. Hence the value of the guide and old offeintiely controlled animal experiments. Clinical results will ever constitute the final test of organicherapy in any given condition, but in

practice rather than medical practice. The combined administration of extracts of organs of known or probable endocrine functions as empirical therapy is based on the following considerations.

1 There is some evidence of mutual interdependence of ome of the endocrine glands. Thus the normal functioning of the gonads depends among other things on the thyroids and possibly the hypophasis and the adrenal cortex, while extirption of the gonads lends in some species to changes in the hypophasis thymus, and the adrenals.

2 Endocrine glands, like the theroids or the principles that have fundamental influences on the general metabolism and growth, will necessarily influence the other glands as well. Apart from this type of facts, the theories of specific influence (stimulation or inhibition) of one gland on others rect on precurious foundations. But it is quite probable that conditions like dietary deficiencies and chronic or reute infections have one effects on the entire endocrine system and more so on some than on others.

3 The above consideration has led to the theory that endocrine disorders are seldom if ever confined to single visitims that they are in fact, pluriglandular. The corollary to this theory is the pluriglandular threapy of these diseases. But it must not be for attent that in the experimental animal specific disease as are produced by damaging specific glands of internal secretion and so jar is organotherapy is at all effective it suffices to administer the product of the damaged gland to control the disease. It is not necessary for example to add pulnturer gonad or sdrend cortex to the thiroid extract to control experimental cretimism or investeding.

4 Fortunstelt, to date most plurighted by therapits have been administration of the mixtures by month. In this way the least damage is done to the patient. But the pecuous theory that we can supply the human body with any quantity and quality of endocrine pabulium the internal coordination being so perfect that the body cells pick out only the kind and quantity of hormones needed is not only without bisss in demonstrated facts, but is in some matances (as the thir roid and possibly the hypophysis and the punctus) definitely contradicted. The fact that most of the endocrine products are more or less inert when then by mouth probably explains much of the success of the plurighandular therapy in the bands of the uncertical.

But you siv, all these considerations and objections to pluri glandular therapy are academic and basid, the point. The whole matter is Does the patient improve or get well on that is because of the plurightudular duct? Yes that is the nub. We can throw the rationals of the therapy to the wind provided the pitient improves and does not relapse when he recurres our bill. All systems of healing, point to sucin metabolism, slight mental retardation or inferiority, etc., may be en tirely outside the endocrine field, and it is now claimed by some that both hyperthyroidism and hypothyroidism may be prisent in persons who have a normal hasal metabolic rate. Larly diagnosis becomes, therefore, essentially gue swork, and the mening of positive results of organication processes of the proceed diagnosis become also a matter of guess. This is undoubtedly one of the most disturbing factors in evaluating the results of organications at present. How are we to proceed with fairness in face, of the following factors.

1 None of the incipient symptoms of endocrine hypofunction are specific

2 Slight hypofunction of any one of the endocrine glands may be only temporary, with spontaneous recovery. Any therapy of such conditions is apt to Icad us to wrong conclusions, and thus impede the progress of medical art and seignee.

3 Prolonged and marked hypofunction of at least some of the gluds of internal secretion (for example the thyroids, paretthyroids, panerers) may induce a more or less irreversible pathology in other organs, render ing late therapy less effective

What is the doctor to do in this dilemma? Is he to apply an in discriminate or plurighuidular theripy in incipient and uncertain cases, on the chance of a random lat, or is he to await developments, thereby possibly harming the prinent?

It would be presumptions for any one man to dictate the line of conduct here, but I think the following points are within reason

1 When the diagnosis is a guess, let us all admit that the meaning of therapentic results is also a guess

2 Internists as well as laborators men should make greater efforts to work out rehable critera of meipient endocrine hypofunctions, and determine more clearly the time factor of the irreversibility of endocrinopathic sequelæ

Uniglandular tersus Pluriglandular Organotherapy —In recent vears there has been a tendency to abandon the use of single gland products in favor of gland mytures. This tendency has been putricularly marked in the case of the thyroid, the hypophysis the gonads and the adramal cortex. We do not inclinde here the extreme tendency in this direction—the inclusion in organotherapeutic mytures of extracts of organs (like the kidney, the lymph gland, the spleen, the brain etc.)—where evidence of endocrine function is entirely lacking and the use of these mixtures is seneral or 'supportive' therapy for all kinds of disorders. This is quack

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- 2 Internists as well as laboratory men should make greater efforts to work out reliable criteria of incipient endocrine hypofunctions, and determine more clearly the time factor of the irreversibility of endoerinopathic sequely.

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The clinician, on the other hand, perhaps knowing less intimately the evidence for the unity of life and organ function in mammals, is apt to become impatient with the strictures of the laboratory worker, and under value the significance of experimental data in the analysis and cure of human ills 'After all,' they asy, the final arbiter is the crucible of the clinic" But in so far as the clinic is or can be a crucible, it is identical with the crucible of laborators research and it is only after repeated refining that either crucible yields pure gold. The following seems obvious (1) certain nervous manifestations of endocrine pathology, especially in the group of consciousness, may differ in man and the dog and the labora tory man must admit that conscious nervous manifestations cannot at present be studied with accuracy in the experimental animal. For ex ample there is nothing definitely known in the spayed bitch identical with the neurocirculatory disturbances of the spayed woman. When the internist reports that these neuroses of the prematuro menopause in his patients are ameliorated by ovarian therapy, the laboratory man has noth ing to say except the very obvious remark that nervous symptoms, es pecially in women, are often profoundly influenced by suggestion. The menstruation phenomena in women are not completely duplicated in the rut of the lower mammals But as regards the other really objective find ings of gonadectomy and conad therapy after castration there is no quar rel between the clinician and the physiologist.

Both groups must also admit the posmbility of differences in actual physiological effects of organotherapy per es in man and the laboratory animals. As pointed out above, hormones given by mouth must pass the following obstacles before reaching their field of action (the blood and issues) the destructive action of the digestive juves the destructive action of the digestive juves the destructive action of the intestinal bacteria, and evaluation of destruction by the in testinal nucosa. So far as we know the digestive ferments are identical in all mammals but there may be species differences in intestinal flora and intestinal permeability. Such differences however, must be demon strated, not merch assumed.

A Complete Organotherapy Probably Not Attainable —In the normal animal, hormone equilibrium is brlaneed by delicate chemical and nervous processes. When this equilibrium is uper by disease, it is probably im possible to restore complete balance by our relatively crude methods of organ extract administration. It must not be forgotten, however, that we are aided by the wonderful plasticity and capacity for readjustment on the part of the organism at least under many conditions. Even our most successful organotherapy (the thysical) is merely a physiological control not a cure for when the therapy ceases the malady returns. When he malady does not return sooner or later when the organotherapy is stopped, we have merely tided the putient over a period of temporary depression of the gland involved a form of gland "rect cure"

cossful cures, to the crucible of their clinics But will you not agree that we must examine the crucible? Pluriglandular therapy as frunk em piricism is not to be wholly condemned, even in the twentieth century But it increases the chances for post hoc fallacies, as few men are content to be mere puppets to the detail man We try to think, at times

It is, perhaps, significant that theyroid extract (the one substance active per os) is so frequently an ingredient in the ready to-serve pluri glandular mixtures, just as alcohol and layatives make up part of many otherwise mert patent medicines For example, one manufacturing con cern lists ten different pluriglandular mixtures, and seven of these are said to contain the rold extract

"Orthopbrenic" (thyroid, pineal, testes-overy prostate, cerebrospinal substance, activating substances)

'Virilogenie" (anterior lobe, adrenal cortex thyroid testes, prostate activating substances)

"Galactagogue" (mamma, placenta, posterior lobe, thyroid, activating substances)

"Morphogenio" (thyroid, adrenal, pituitary, pineal, thymus, activating substances) Catabolic" (thyroid, posterior lobe, adrenal medulla, aperminum, ac

tivating substances) "Feminilogenic" (pituitary, adrenal, thyroid, corpus luteum, ovary

mamma (virgin), activating substances)

'Osteoplastic" (thyroid, pituitary, parathyroid, adrenal medulla, thy mus, activating substances)

We are not informed what the "activating substances" are, except in the case of the thyroid, where it is said to be rodids. The use of these mixtures thus amounts practically to dosage of the patient with thyroid extract and potassium iodid

Experimental versus Clinical Organotherapy - Despite the minor difference in species in the kind and everity of symptoms induced by specific endocrine pathology, and minor species differences in the effects of organotherapy, it is a striking thing that in all securely established facts of endocrine diseases and therapy, there is a practically complete parallel between the experimental mammal and man. We need mention only the thyroids, the parathyroids, the gonads, the pancreas This fortunate fact rendered possible the rapid advance in the analysis of endocrine diseases in the last fifty years This fact also tends to render the laboratory in vestigator skeptical in relation to therapeutic results on min that cannot be duplicated in the laboratory, especially if the chinical reports include such variables as guessing the diagnosis several synchronous therapies, and madequate controls in the way of the natural history of the disease

In the adult normal annul the thyroid is made up of active of cubuidal cells with the thyroid colloid filling the center of the limen. In mamm is this adult structure begins to appear it or a little before birth. In early intra uterine life there is no colloid or definite arrangement of the cells into actin.

The colloid is obviously a cell product (cell degeneration or cell secretion) But its relation to the sland function is not yet clear. Bensley his succeeded in stanning an intracellular thyroid colloid. This colloid is most doundant in the region of the cells adjacent to the lymph vessels and blood rescale. It is usually held that the colloid in the lumen of the sum represents a storige state of the physiologically important internal secretion which according to the needs of the body becomes changed, is real-sorbed by the cells and passes into the blood stream.

The blood and lymphytic supply to the throud is very abundant so that the blood flow through the gland per mass of tissue is greater than in any other origin in the body. Mainly and Marine have shown that a piece of thyroid trinsplanted in other regions of the body stimulates the development of a similar extraordinary blood supply. The great vascularity of the thyroid is therefore intimately related to its specific function.

Significance of the Thyroid Innervation -Branches from the cervical sympathetic nerves pass along the thoroid vessels to the gland These theroid nerves have with certainty a vasomotor function. Their stimula tion causes primary vesoconstruction of the gland and this is followed by vasodilatation at the end of the stimulation. The question whether there are also true secretory fibers in the thyroid nerves has been at tacked by diverse methods without as vet yielding conclusive results A her and Flack, also Ossakin report that stimulation of the thyroid nerics increases the excitability of the depressor reflex mechanism due to an increased thyroid secretion thrown into the blood Rabe et al found that the stimulation of the nerves reduces the rodin content of the gland and this was confirmed by Watts but the latter investigator also found that identical decreases in iodin were induced by mechanically produced circulatory changes (temporary vasoconstriction) in the gland Watts findings are questioned by Van Dyke Cannon reports that a successful union of the phrenic nerve with the cervical sympathetic induces some of the symptoms (nervousness exophthalmos increased metabolism) of thyroid hypersecretion owing to the continuous respiratory nervous dis charges from the phrenic acting on the gland cells. The fact itself is contradicted by Troell but if it shall be proved correct as reported by Cannon, the excessive thyroid activity may be due to circulatory rather than secretory nerve disturbances Cannon also finds that stimulation of the thyroid nerves produces an electrical change in the thyroid similar to that induced in muscle or in nerve when thrown into activity. This

#### THE THYROID

The employment of thyroid in human medicine in cases of congenital absence, atrophly, or destructive lesions in the gland is a typical cross hormone therapy. It is also in reality our only well established case of successful organotherapy. The marked result with this organ has been the main impetus and guide in the attempts to work out an organotherapy for the other endocrine glands. The thyroid produces a substance or substances of specific phisological importance, stable in ratiro not destroved by the digestive junes or the haederia of the alimentary card, and absorbed in active form into the blood. The functions of the gland may be partly replaced by the administration of the gland. So well established is this principle that conditions of the thiroid can be diagnosed in nart from the effects on the body of the administration of the gland.

The administration of the thyroid in organotherspecifics is based partly upon clinical and partly upon experimental work. The latter preceded the former, but the two methods have been closely combined, each reacting upon the other. The gland was not employed in medicine until a rational basis for its use lad been established experimentally, empiricism

had no part in its introduction

The most important steps in our knowledge of the thyroid are the following (1) the demonstration (hy Schiff, Riverdin, Kocher, and others) that extripation of the thyroid in adults leads to a crees of disturbances designated by the term cacheria strumppria or myvedema, (2) the experimental production of cretims by removing the thyroid in young animals, and the recognition of sported and endemic cretimism in man as due to hypothyroidism, (3) the demonstration that the symptoms of hypothyroidism can be partly controlled by thyroid administration (Evald, Bummann Magnus Levy, Pick and Pineles, Murriy Howitz, Mackenze, Fox, Kocher, and others), (4) the discovery of the thyroidin and the subsequent studies of specific thyroid chemistry (Baumann, Oswald, Hunt, Marine, Koch, Lendall) (5) the demonstration of a relation of thyroid physiology to the duet (Wutson, Hunt, Marine, Burget, Bensley) and possibly to infectious processes (McCarrison Rosenow), (6) the studies of the possible control of thyroid activity through secretary nerves and circultory changes (Asher, Watts Cannon, and others)

From the strudpoint of climical medicine some of the most important problems in thyroid physiology remain yet insolved, namely, the cause and significance of the thyroid changes in so called toxic gotter in

man and the cause of endemic goiter

Function of the Thyroid —The thyroid develops from the epithelium of the branchial clefts of the embryo The embryological anlage of the thyroid is thus similar to that of the parathyroids and the thymus gland

In the adult normal animal the thyroid is made up of acini of cuboidal cells with the thyroid colloid filling the center of the lumen. In maximals this adult structure begins to appear at or a little before birth. In early intra iterine life there is no colloid or definite arrangement of the cells jeto acini.

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he interprets as proving a direct secretory nerve action. However, Schafer has reported similar electrical changes in the maninary gland on injection of pituitrin, and it is now demonstrated that pituitrin enness, not milk secretion, hut merely a discharge of the milk present in the duct sistems by contraction of the dust musculatures. Moreover, the electrical response in the thyroid, as reported by Cannon, was sometimes positive and sometimes negative. It does not seem possible at present to interpret both of these effects as due to an increased secretory activity. Moreover, denervation of the thyroid in normal number does not produce hypothyroidism, and transplanted fragments of thyroid appear to function in a normal manner without neries. Cinnon, et al. also report that stimulition of the thyroid nerves leads to a temporary acceleration of the denervated beart. They interpret this heart acceleration is due to an increased thyroid secretion. This interpretation is at present open to question.

If secretor nerves are present they are certainly not necessary for the normal gland function. The control of the gland activity is, therefore, essentially a bumoral one, as indicated by the great viscularity. But the question of thyroid secretory nerves is, nevertheless, one of great practical importunce in relation to the cause and control of possible byper thyroidism.

Chemistry of the Thyroid—The older investigators reported the presence in the roid of albumins, nucleoproteins, albumoses, leuon, vanbin, hypovanthin, lactic and succinic acids, etc. In glands which have under gone evente degeneration the finding of mucin, cholesterin, methemoglobin, bile pigments etc. is reported.

Iodin—Since the discovery, in 1895, by Baumann, of todin in the thyroid, interest in the chemistry of the gland has centered largely around this element, and the substances with which it is in combination

The amount of iodin in the throad, not only of man, but of the lower animals is extremely variable, being influenced by age, character of the food locality, the physiological conditions of the throad and man other for the most part unknown, factors. The thyrods of infants and of newly born animals contain less iodin than adult throads, in fact, it cannot be detected at all in many cases at least not by the use of usual quantities of the gland, and by the assoil methods. But the same is true in many instances of the thyroid of adults and, to all appearance, nor mal animals. Achbacher gives the average amount of iodin in the human thyroid between the ages of twenty five and thirty as 8.98 milligrams, it is less both in youth and old age. The percentage based on the weight of the dry gland varies from 0 to 0.4 or 0.5. Extreme variations both in the total amount and in the percentage occur. The thyroids of salt water fish contain three times the amount of iodin usually present in the manumalian throads. In some of the marie invertebrate iodin

is present in greater quantities in some of the outaneous and everetory structures where the iodin cannot have the physiological significance it has in the through of the vertebrates

The nature of the physiologically retire iodin complex in the thyroid is devoted to the problem. The form is specific for the thyroid no other iodin compound is known which has the specific physiological properties of the thyroid subtance or hormone (no Furth Schmatz Juch Hutt and Scidell). It is known to be united in some way to the proteins probably to one or more of the amino acid constituents of these (Roch, kendall, Cumeron).

Baumann realated a specific but ill defined indin compound from the thyroid one which has at least many of the specific properties of the gland substance itself. He named this substance "indothyrin"

Owald isolated, at least approximately the protein with which the ionic is combined. He insmed this protein 'thy rogobulin' it was found to constitute one-third to non-lift or more of the weight of the dry gland. The iodin content varied from 0 to 0.86 per cent or more. Owald believed this thyroglobulin if it contained iodin, to represent the true active principle of the thyroid, Baumann's iodothy rin could be obtained from it by hdrolysis.

Oswald also isolated an iodin free protein having the properties of a nucleoprotein this protein did not have the characteristic physiological thyroid serior

F C beck found that as determined by the acetonitril test of Hunt the thyroglobulin as well as the metaprotein fraction of the thyrod in tained the full physiological activity of the entire thyrod. Further hydrivas into adotherm and primary or secondars albumoses shows a graduly decreasing activity, while the amino and fractions show little or niphysiological activity although they retain some of the iodin. The thyrometaprotein of beck contains these times the percentage of iodin found in the entire thyrod jet it shows no greater physiological activity than the dried thyroid. The relation of the iodin to the physiological activity than the dried thyroid. The relation of the iodin to the physiological activity of the thyroid thus appears to be a direct one. Hunt has reported that kendell s thyrovin is less effective than ordinary dried thyroid as determined by the acctionital test.

Thyroxin—Kendall has isolated and analyzed a crystalline compound (CnHi_BO₂NI₂) from the thyriid having three molecules of rodin fixed in a protein derivative almost identical with tryptophan. This substance is called 'thyroxin' Kendall thinks it is the active thyroid hormone on the whole the action of thy roun prailleds that of crude thyroid extrict in man and animals that have some thyroid gland left. It has not been proved that thyroxin is effective in absolute critinism. This would be crucial test of the true hormone nature of thyroxin. The thyroxin is the crucial test of the true hormone nature of thyroxin.

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ologically active thyro-rodin compound Possibly the thyroids may store rodin outside of this compound, for example in the colloid Kendall has obtained inactive rodin fractions from the thyroid

Several writers have called attention to the variation in the iodin content of commercial thyroid preparations. Hunt and Seidell found the preparations on the American market to vary from 0.00% to 0.38 per cent. The average was approximately 0.2 per cent.

It is thus evident that the commercial preparations vary by as much as 400 per cent. Such variations in the strength of most drugs would be considered intolerable and there can be little doubt that more satisfactory therapeutic results would often be obtained if the thyroid preparations were more uniform in strength That lack of uniformity does not cause more inconvenience is due largely to the fact that thyroid medication must, by its nature be peculiarly individual the do e must be governed by the degree of thyroid deficiency of the patient and this can only be determined by trials with different do es 1 When however, the proper do igo of a certain preparation in an individual case has been determined. it would be distinctly advantageous to be able to continue the same dosage if a fresh supply were pre cribed. At present even if the same firm s preparation were prescribed the second order might be several times as active as the first Hence, it would be very desirable for the pharmaconeia to fix a standard rodin content for the official preparation a standard of 0 9 per cent would cem reasonable (Hunt and Seidell) This iodin con tent must, of course represent the physiologically active thyroid substance and not the addition of other organic or morganic iodin. For that reason the chemical standardization by means of the rodin percentage should be supplemented or controlled by physiological standardization (the acetonitril method of Hunt, the cretin method of Bisinger or quan titative determination of the thyroxin content)

The rodin in the thyroid is both in the colloid and in the cells. There is a fairly uniform ratio of distribution two-thirds being in the colloid

and one-third in the cells (Tatum Van Dyke)

Relation of the Thyroid to Diet—It has been shown by Watson and Burget (on the rat), Marine and Lenhart, and Gaylord and Marsh (for the salmonoid fishes) and Benslev (for the opossium) that a high or other was abnormal protein diet induces thyroid hyperplasia and marked en largement of the gland. But this appears not to be true for the guinea pig (Loeb) In the case of the hrook truit this hyperplasia followed feeding with mammalian liver or uncooked aimal protein and was promptly stopped by feeding with fish or cooked ment. McCarrison was able to induce thyroid hyperplasia in rats by feeding extricts of feeces able to induce thyroid hyperplasia in rats by feeding extricts of feeces.

I ha e met with one case of hypythicroid m with intense intolerance to any form of thyroid medication. This is ther fore a factor in dosage in rare instances.—
Editor

can be given hypodermically or intrivenously. As measured by the effect on the basal metabolism on hypothyroid patients, the influence of a single injection of thyroxin is in evidence from four to seven weeks after an initial latent period of two to four days. The quantity of thyroxin obtainable from the thyroid is very small. Not all the iodin in the thyroid appears to be combined with thyroxin. Kendall estimates that there are 14 milligrams of thyroxin in the bold tissue (min), ecdiparts of the thyroid. Plummer estimates that the normal human adult uses up from 0.5 to 1.0 milligrams thyroid hormones per day. Hence, the normal thyroid secretion should be at that rice.

Relation of the Iodin to Physiological Activity of the Thyroid-Banmann's discovery of todin in the thyroid stimulated an immense amount of work and led to the accumulation of a large number of facts as to the occurrence of rodin in the thyroid of various animals, and in that of man, under various conditions, both pathological and normal The fact that rodin can frequently not be detected in the thyroids of healthy individuals has led many to doubt whether this element is a necessary or important constituent of the gland (of Hunt and Seidell, Cirlson and Woelfel) From almost the beginning there has been evidence, not very conclusive, however, that the activity of the thyroid when used as a drug is clo ely dependent upon its iodin content. Thus, Roos in three experi ments upon dogs found that more natrogen was exercted after the ad ministration of thyroid rich in jodin than after that of thyroid containing little iodin Oswald, in two experiments, allo found thyroglobulin rich in jodin to cau e a greater exerction of nitrogen than did there, lobulin poor in todin Marine and Williams found in two experiments that feed ing thyroid containing a larger percentage of iodin chised a greater loss of weight in dogs than did a preparation containing a smaller percentage
Hunt and Hunt and Seidell, in extended series of experiments, in

Hunt and Hint and Seidell, in extended series of experiments, in which the effect of thyroid npou tho resistance of animals to certain poisons was determined found a close parallelism between the physiological activity of the thyroid and the iodin content. They also found that the nodin which accumulates in the thyroid after feeding iodin compounds is present in an active form, that is, in the form chiracteristic for the thyroid. In the same species large thyroids (goiter) contain is smaller percentage of rodin than small thyroids, and correspondingly expressed junce from large thyroids exhibits less physiological activity than that from small thyroids.

Although further chuical tests are desirable, the above experiments offer almost conclusive evidence that the therapeutic value as well as the taxic action of the great preparations is directly proportional to the indim

toxic action of inform preparations is activity proportions to the holicontent (Kocher). It is well established that feeding indin in any form leads to a rapid increa e in the fodin in the thyroid, but it is not known whether the fodin thus stored is immediately incorporated as the physical components.

blood of thyroidectomized cats yields a positive acctonitril test—a fact which seems to question the validity of the test itself

Baunger repeatedly trunsfused blood of normal rabbits into cretin rabbits without observing us affects on the cretin conditions but when similar transfusions were mado into the cretins of blood from rabbits fed varying quantities of commercial thyroid the cretin condition was in fuseced in the same manner as hy feeding thyroid

It is altogether probable that the throod scention is present in normal blood, but in too small concentrations for detection. This is indicated be some work of Woelfel and Luckhardt. These investigators find that when blood from dogs with high sodm content of third is transfused into dogs (previously blod dry) with low rodm content of the throod into dogs (previously blod dry) with low rodm content of the throod the precentage of sodm in the thyroid of the latter is increased. This seems to show that there is a balance or equilibrium between the stored throod secretion in the blood. This gives us hope that the question of thyroid secretion in the blood. This gives us hope that the question of thyroid ceretion in the various types of thyroid hyperplism may yet be solved by blood analysis. The presence of thyroid bendernestrated (Hutteen and Carlson)

Relation of the Iodin to Histological Structure of the Thyroid -If iodin is a necessary constituent for normal thyroid function it would seem that it would be equally necessary for normal thyroid structure. Never theless in exceptional cases in most animals and as a rule in some species, todin in structurally normal thyroids is either absent or so small in amount that it cannot be demonstrated by our best chemical tests The most significant findings in the relation of the todin to this rold struct ture are the observations of Marine Bensley Loeb and others namely that most types of thyroid hyperplasia can be arrested and converted into a colloid or resting state by the administration of iodids in any form It is now generally agreed that the simple thy roid hyperplasia of endemic gorter, adolescence, etc. can to a large extent be prevented or controlled by small quantities of iodids We are not permitted to conclude from this fact that the hyperplasia which is controlled in this way is due to lack of iodin in the food or in the body This arrest of hyperplasia may be a drug action of the iodin, or an evidence of a detoxicating role of the thyroid, as suggested by von Cyon the excess of inorganic or toxic iodin being converted by the thyroid into a non toxic or less toxic form Accord ing to Bensley, the thyroid hyperplasia induced in the opossum by ex cessive protein diet is not arrested by iodids.

According to Jones and Jones and Tatum, increasing the rodin content of the thyroid increases the standality of the thyroid colloid so that the amount of rodin in the gland can be in part determined by the rejection of the colloid to Mallory a connective tissue stain

The specific affinity of the rold tissue for iodin is retained in certain

from gotter patients But we are not permitted to generalize from these observations, although they are both interesting and important, for high protein diet, or feces from gotter (toxic) patients fails to induce these theyroid changes in other species (cat) Evidently the thyroid stability or factor of safety vines greatly in different species

Feeding meat is said to reduce the iodin content of the thyroid Th

may be a factor in the hyperplasia

Teeding thyroid, food rich in iodin or iodids, tends to increase the colloid in the thyroid, as well as the total iodin content in the gland Thyroids in the process of compensatory hypertrophy seem to form an exception (Loch)

Hunt found that mice fed on oatmeal or on oatmeal and liver showed a much greater resistance to accionistil than mice of the same litter fed on eggs, crackers and milk. He averibes this difference to a greater stimulating action of the oatmeal and the liver diets on the thyroid gland.

Prolonged starvation or vitamin A free diets lead to degeneration

and strophic changes in the thyroid (Jackson, Tsmil)

Secretion versus Detoxication -Bensley and others claim to have identified the thyroid secretion in the cells by microchemical methods much in the same was as the secretion granules or pro ecretion of the digestive glands have been brought out by staining. But the presence of the secretion as a normal element in the body fluids has not been demon strated Our strongest evidence that the thyroid works by the mechanism of an internal secretion rather than hy processes of detoxication is the result of thyroid organotherapy an experimental and clinical hypothyroid These results are capable of no other interpretation But this does not exclude detoxication processes in the thyroid, in fact von Cyon s theory is partly true. Because of the special affinity of the thyroid for rodin, rodin compounds of all kinds-including the more or less toxic in organic iodids-are taken out of the body fluids and turned into the less toxic thyroglobulin But this work can be performed by the kidneys as an elimination process, and at any event it is of secondary importance in thyroid physiology for much of the thyroid function can be taken by the dried and dead thyroid product.

The Thyroid Secretion and Body Finds—Probable as it seems from experimental and clinical data that the normal thyroid yields a secretion to the body fluids, yet it must be admitted that this secretion has not yet been demonstrated in the blood or the lymph, even in the lymph taken directly from the throid gland. The colloid observed, by histological methods, in the thyroid lymphatics is probable an artefact. The action tril test on normal blood of men and animals is negative (Hunt, Carlson and Lussky). Even in cases of blood from exophtbalmic goint patients the method yields inconclusive results. Trendelenburg reports that the

women there frequently occurs what may be called a streetly physiological hyperplana at puberty, at menstruation and during pregnance although some of the cultigement of the thirvoids at these periods may be simply due to increased vascularity. The period of active growth of simple or being gotter is really a period of beyteplass. According to Marine a colloid gotter represents a relatively resting stige of a privious hyperplass. Finally in so-called torus gotter or Basedow side-view, there is usually prohiferation of the thyroid cells increase in gland volume and gland vacularity with decrease in gland colloid. It may be considered as a general rule that the amount of colloid in the thyroid is inversely proportional to the rate of cell division and growth of the gland at any period.

In moderately severe cases of Graves disease Gevelin reports that 7 per cent of his cases showed a lowered sugar tolerance. Milder cases have commal blood surj. Fredmen throad to may dematons patients

may induce hypergly cemia

It must be noted in the first place that more uncrease in cells and gland valume does not mean increa ed activity or increase in the secretion A meri fraction of the normal thyroid suffices to meet the normal needs of the organism. This means that the thyroid under normal conditions does not work up to full capacity bence it should be possible to increase greaft the rate of thyroid secretion without increase in the number of cells. If, as seems probable, the thiroid a truit is governed mainly be the blood, doubling the thyroid volume would no more increase the thiroid secretion than doubling the kidnes volume would mercese the quantity of urme. The returns experiment has not been made, but we predict that when made that is when two healthy kidness are successfully implanted says on the carotids in the need, the sum toted of the urine secreted by the four kidneys will be no greater than that secreted by animals own kidness before the muchantation.

In the second place, cland cells in condition of active division and probletion are probably not sufficiently differentiated to perform a highly specialized function. And in the third place, we have as yet no reliable test histological physiological or demuel for the rate of throad activity at least coviring longer periods than ordinary crucial experiments. Let the commonly accepted theory to-day is that of Mobius manch, that the throad hyperplasia in tonic gotter represents throad hypersecretion and that the hypersecretion is responsible for the toxic symmetry.

This last theory is based mainly on three lines of evidence (1) symptoms similar to the syndrome of torus goiter are produced in man by excessive thyroid administration, (2) patients with tone goiter appear on the whole to be excessively sensitive to thyroid administration (3) in main cases the symptoms of torus goiter appear to be at least partly

stages of malignant growths of the thyroid, primary and secondary Whether the iodin complex in these thyroid tumors represents the active thyroid hormone has not yet been established

Sweet and Ellis report that removal of the external function (pan creatic digestion) of the panere is leads to an increase of jodin and col

loid in the thyroid glands

Relation of Thyroid Hyperplasia to Thyroid Neoplasm —Thyroid hyperplasia predisposes to thiroid neoplasm. In dogs, malignant growths of the thyroids with typical bone, lung, and liver metastases are not in frequently found on the hasis of an old goiter. We have never seen them start from a normal thyroid. Regenerating thyroid issue (compensator hyperplasia) mas show powers of mrasion like cancer (Loch)

The line of demarcation between simple hyperplasia and miliginary we option of the demarcation between simple hyperplasia and miliginary we spreading growths appears to be a normal phonomenon in the digroid of fishes, where the glands are not surrounded by a councetive tissue capsule (Gudernatesh). This has led to contradictions and confusions in the interpretations of the thyroid hyperplasia or thivoid cancer so common in salmonoid fishes, especially under domestication. Marine and Lenhart regard these thiroid growths as simple thyroid hyperplasia, since they respond to the same measures that modify simple thyroid hyperplasia, since they respond to the same measures that modify simple thyroid hyperplasia, since they respond to the same measures that modify simple thyroid hyperplasia as manignant neoplasm. This appears to the writer as extreme position. If this view is turble for fish, it should be equally tensible for mammals, in which case through hyperplasia in man and other mammals hocomes a cancer problem. Gudernatisch has pointed out that the metastisses of normal fish thyroids do not cause destruction of adjacent tissue. The same is certified to some time before metastic growth occurs, so that a sharp line between simple hyperplasia and malignancy of thiroid erowths cannot be drawn.

# HYPERTHYROIDISM, EXPERIMENTAL AND CLINICAL

Toxic Goster — The effects of hypothyroidism experimental and clin wal, are clear and their control is partly in our hands through organization of the case in the same of the same and effects of hyperthyroidism—if, indeed, there is such a thing as continued hyperactivity of the throid with attendant symptoms of discase. Hyperhism of the throid gland occurs in man and animals under many conditions. We have seen that in some animals it may be experimentally induced by the diet. In

Some malignant growths of the thyroid are assiciated with the clinical picture of evopothalmic gotter—Ed tor

bound up with the question of the cause of the hyperplasia. It will probably be found that we are dealing with a complex of causes (abnormal det deranged metabolism specific and non specific in frections nervous distriangements, etc.) That the hyperplasia in experimental animals is primarily due to changes in the blood appears to be shown by the experiments of Manley and Marine. The transplant of a normal thyroid into an animal with active thyroid hyperplasia becomes hyperplasiae, and vice versa. Pups from bitches with active thyroid hyperplasia are born with hyperplasia thyroids or going (Carlson).

The interpretation of the nature of throud hyperplass in toxic gotter is further complicated by the fact that, in many of the lower animals throud hyperplasia, histologically identical with that of toxic gotter in min is pre-cut without any other of the Basedow's suddrome. In fact printingous Ba edow as well as spontaneous eventumes is very rare, though

apparently not unknown, in animals below man

The justification for this rather length, discussion of hyperthyroidism in a chipter on Organotherapy is our desire to point out that the existince of actual thyroid hyperscretion with consequent symptoms of disease is till in question, also that it behows clinical and laboratory workers to tet a men prevalent theories in the hope of reaching a clearer knowledge and a better control of a very scrious malidy be it through organotherapy or other meliums.

According to Marine and Baumann the excessive metabolism and fever following removal or serious training to the adrenal cortex is privented by thyroidectomy. It this is true it would seem that the thyroid gland is at least temporarily disturbed (increased secretion) directly by tho withdrawal of the adrenal cortex hormones or by toxins produced in other parts of the body in the absence of adrenal cortex function.

#### HAPOTHYROIDISM IN CHILDHOOD

Oretinism—The most marked effect of the removal of the thyroid in young sinnals and of its atrophy or injury in children is a cesation of growth and development both phaseal and mental. The changes in the skeleton are especially mirked there is a cresation or retardation of the normal oscillation of the certilages. The epiphysacle ends of the long lones grow slowly, while the prior to til essitication may be normal or in excess. The extremities are relatively short and thack the pelvis is small. This condition and the miscaltry dependent on are responsible for the protrading, aldomen. Abnormalities in the growth of lone are largely responsible for the characteristic shape of the shall and thorax in creting the control of the state of the characteristic shape of the shall and thorax in creting the control of the characteristic shape of the shall and thorax in creting the control of the characteristic shape of the shall and thorax in creting the control of the characteristic shape of the shall and thorax in creting the control of the characteristic shape of the shall and thorax in creting the control of the characteristic shape of the shall and thorax in creting the control of the characteristic shape of the shall and thorax in creting the control of the characteristic shape of the shall and thorax in creting the control of the characteristic shape of the shall and the control of the characteristic shape of the shape of the characteristic shape of the characteristic shape of the characteristic shape of the characteristic shape of the shape of the characteristic shape of the

If the thyroid deficiency does not occur until rather late in childhood the above changes may be ab ent, and the hyperthyroidi m may be evident

ouls in a cessition of normal growth

controlled by surgical and medical measures that reduce the thyroid volume and presumably the thyroid activity

The most striking symptom of toxic goiter is the greatly accelerated metabolism DuBois, Plummer and Boothly, Means, and others have shown that in severe cases this may be increased 75 per cent above normal, and an increase of 50 per cent in moderately severe cases is not uncommon. In mild cases the state of metabolism may be practically normal DuBois thinks that some of the other symptoms (tachycardia, high blood pressure, high temperature, nervousness) are in part secondary effects of augmented metabolism with the attend nut increased production of heat DuBois also showed that there is no conservative form of treatment of toxic goiter that reduces the metabolism rate to any greater degree than mental and physical rest. These measures may lower the rate more than 10 per cent, while in some cases ligation of the thyroid arteries actually increased the rate of metabolism.

Experimental hyperthyroidism has not set been produced. There is no evidence that the rat, fish, and opossum thyroids of Watson, Marine, McCarrison, and Bensley secreted in excess. It is true that excessive thyroid feeding, especially in man, duplicates most of the symptoms of exophthalmic goiter, but the same effects would probably be produced by any other substance that had a similar effect on the metabolism rate. It is biologically significant and cluwedly important that, of all animals of ar studied man is the most susceptible to the deleterious effects of thyroid feeding. The attempt of Cannon to induce hyperthyroidism by union of the phrenic and cervical sympathetic nerves has already been referred to

There are not wenting other interpretations of the nature of the roll hyperplasia, especially in toxic goiter. The most important art the per seried secretion theory and the compensator hypertrophy theory, especially as elaborated and upheld by Marine. According to Marine the hyperplasia in goiter is a response of the thiroid to in increased need of the body for the secretion in consequence of some disarrangement in the general metabolism, in fact, despite the increased secretion in toxic goiter, there may be an actual thyroid deficiency owing to the gruter need for the secretion. On this theory, there is room for at least a careful experimental thyroid organotherapy in focus goiter, and, in fact, fairorable results from thyroid feeding in toxic goiter, and, in fact, fairorable present clinicians. If the thyroid hyperplasia of toxic goiter is not primary, but compensatory in nature, we expect thiroid feeding to reduce the hyperplasia. Loeb has shown that the true compensatory hyperplasia following extirpation of the larger part of the thyroids is prevented by thyroid feeding. It is not prevented by iodids, thymus, or tethelin feeding.

The nature of the theroid hyperplana in toxic goiter is, of course,

Complete thyroidectomy in experimental animals appears to prevent sexual maturation entirely and thus leads to sterility

The cretin symptoms following complete thyroidectoms in the young but otherwise normal animal do not appear until late after the operation (three to six weeks or longer)

Spontaneous cretimism is rare in the lower animals. In man it is sportade as well as endemie and in either case it may be congenital or a matter of gradual development after hirth (primary atrophy cystic or colloid degeneration). The physiological state of the maternal thirtoid during gestation influences the thyroid of the fetus. Thus if the mother



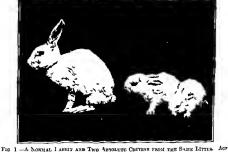
Fig -Saiv Lesions Developed in Thursdo fed Absolute Cretius Live Months after Discontinuing the Thursdo Treatment (Easin r)

has marked throud byperplass during pregnancy the offspring is born with calar_oed thyroid on the other hand simple colloid goiter in the mother his no influence on the fetal throuds. It is also reported that complete thyroidectomy in the mother leads to throud hyperplasia in the offspring.

The thyroid hyperplasia of the joing from mothers having active throid hyperplasia during pregnancy is probably not an instance of tru inheritance, but a matter of fetal environment. The same conditions that induce the hyperplasia in the mother, acting through the blood produce the same effect on the fetus. Hence it is primarily a himoral, not a nervous effect. But there may also be true inheritance factors in both simple and toxic goiter.

The hair on the pubis and in the swille is scanty or absent, and the sexual organs are poorly developed, while puberty, if it occurs at all, is late The skin in children is often myxedematous Metabolism is much depressed (Bergmunn, Munsfield, DuBois), and the oxygen absorption and mitrogen exerction may be but one-half that of the normal

It is difficult, however, to distinguish between primary and secondary effects of injuries to the thiroid The latter cause marked changes in the nutrition and metabolism, and these may be the immediate cause of some of the abnormalities now ascribed to the direct influence of the



THREE MOUTHS Control rabbit 1 630 grams eretins 460 and 840 grams (Basinger)

thyroid There is evidence that hypothyroidism leads to increased growth of the hypophysis, the adrenals, and the islands of Langerhans in the pancreas We cannot at present say whether or not these changes are compensatory in nature The evidence seems to be to the contrary, at least as regards the changes in the hypophysis

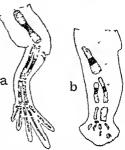
The effects of thyroid insufficiency upon mental development are no less striking than those upon physical development the pitients are apa thetic, the expression is stupid, and idiocy frequent. There is evidence of desenerative changes in many of the organs and especially the muscle The fatty dependration of the muscle is, at least in part, responsible for the feeble heart, muscular weakness, and characteristic "pot belly". There is also decreased resistance to infection, and, strange to say, increased susceptability to thyroid administration

corpuscles are common. There is lowered resistance to infection Metabolism may be depressed carbohydrate tolerance as increased. Degenerative changes in the openes and testes have been described

Thyroid Administration in Hypothyroidism—The most marked effects of the administration of thyroid is about or deficient and it is upon the results in such cases that the therape time we of thyroid is based. Fresh or directive thyroid has been of reventive thyroid has of reventient to the therape there is the thirty of the solid or even better results than various isolution products of the elind such as model and the solid products of the elind such as

the twodyn and the roam Administered in appropriate doors to cases of apporative cetting and infantile merce demy, there is at first 1 loss of weight with improvement of the skin Gyanosis dis appears and the blood to comes normal Growth both bothir and mental recommences and may take an almost normal course. The hair knows rapidly and becomes

glo sy the teeth and nasts also



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gron There is a distinct acceleration of metabolism The mental improvement is most merked in voun, children 'similar results are obtained in critinoid maintals (Pick and Pincles Bisinger and others)

In complete absence of thyroid tissue no amount or duration of throud administration will bring the final growth up to the normal. Thyroid organotherapy is therefore not a complete substitute for the lung organ. This is not surprising in view of the extensive degeneration found in practically all the organs in absolute certain in

Many attempts have been mule to stimulate growth in conditions other than cretinism by thyroid administration. Thus it has been extensively treed in idiots and backward claddren. It has been administered in cases of delayed mono of fractures on the theory that it would hasten union by stimulation of the specific bone metabolism. Hunter found that thyroidectomized sheep on starvation showed no starvation acidosis, but they exercted more introgen than the controls. They showed no diminished oxidation, at least vs regards purin citabolism, but the sugar tolerance appeared to be increased. Manisfield and Ernst state that there is no increased rate of protein cutabolism in experimental fovers in thyroidectomized animals. According to Herring complete thyroidectomy in cats and rabhits has no effect on the epinephrin content to the adrenal glands unless parathyroid tetany develops, in which case there is a decrease in epinephrin. But in the cat, feeding large quantities of raw, or thyroid increases the epinephrin content in the gland by more than a third, Miura states that thyroidectomy does not influence alimentary and phlorizin glycosuria or the animal, but diminishes somewhat epinephrin glycosuria Contrary to earlier reports (Lorind) thyroidectomy does not appreciably influence pancreatio diabetes Auschemko has described certain changes in the phosphorus and lipod content of the blood and organs after thyroidectomy in animals

### HAPOTHAPOIDISM IN THE ABELT

Myxedema—Thyroid deficiency in the himmin adult is seen most typically in invections, which is characterized by physical and mental inertia, and by changes in the skin, depressed metabolism, etc. The skin is white and thickened, due to the growth of granulationlike tissue and an infiliration with a substance resembling miner, the secretions are scanty or absent, the skin becomes dry and rough, the hur falls out There are frequently abnormal sensations of taste, smell and hearing The temperature is subnormal and the pulse slow and weak. There are diminished oxygen absorption and carbon diovid secretion, there is a tendency to obesity, although the patients usually eat little. The metabolism is depressed to a greater degree than in any other known condition

I usk states that it is possible to explain the reduced temperature as due to disturbances in the nervous mechanism of temperature regulation, and that the lowered temperature may be an inflaence in reducing the metabolism of the cells. The congulation time of the blood is stated

to be shortened (Lidskey)

The effect of thyroidectomy on adult animals is variable True myxedema is variety if ever developed This leads one to question whether myxedema in man is pure hypothyroidism Monkeys do not show con ditions analogous to myxedema in human beings, at least for months or years after the operation (Mink, Kishi, Vincent and Jolly, Halpenny and Gun) Many adult animals show little change after the removal of the thyroid, although exzema, conjunctivitis rhimits and other indications of citarrih of the respiratory passages, and especially emacation and dimmution in the number of red and increase in the number of white

the urine. The consumption of oxygen may be increased 70 per cent. The temper, ure rises, the pole is the increased there is usually a striking loss of weight due to the disapperance of the mysedomatons infiltration and loss of fat. The entire metabolism is brought buck to the normal level or raised slightly show the normal. The skin approaches the normal sweating which is usually, turtied what it is myadema, becomes possible. The hair grows ugun uenstruation reippeurs the lowels become regular, the mental condition is much improved. These changes begin in three to four weeks with the usual docks of thread

The first mysdematous patient treated with this oid extract by Dr. Murray, be inning 1891, died in 1720. During the e twenty mine years

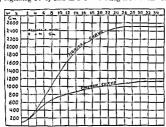


FIG 4C —CROWER CEMES OF FOR A NORMAL CONTENT, PARSITY TWO AR OLUTE CRETING AND BIX AR OLUTE CRETING TRAVEL OF PERSONS WITH HYPERTITING DECOMERKY (Pr. no. r.)

the patient enjoyed ordinary good health and the myxedema was kept under control by continuous thyroid fee lin-

The marked change in the skin in cases of myxedian produced by the administration of the rod live led to the extensive trial of this substance in other abnormal conditions of the skin.

Thyroid Feeding in Conditions of Mild Hypothyroidism—In addition to the above conditions in which there is obviously a vere thyroid deficiency, there are a number of conditions of thy polluroid in of a less severe type. But it must be admitted that the diagno is of hypothyroidism in borderland ex est is at present very waterstam. Nocher statis that many cases which have been treated for anomal childrens scrotling acrousness and disturbances of men trustion a can be him clearly to it.

Administered to cases of myxedemi of cichevia thyreopriva, the myxedemiatous condition largely disappears. There is a marked increase

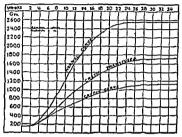


FIG 4A -GROWTH CURVES OF FOUR NORMAL AND THREE ABSOLUTE CRETIS RARRIES SAME LITTER (BRINGEY)

in metabolism. The exerction of nitrogen in the urine may be increased 100 to 200 per cent. This increase results largely from the increased

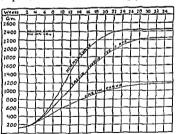
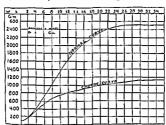


Fig. 4B -- Growth ( urvet of Four Kormal Control Raebits Five Absolute Cretins and Eight Absolute Cretins Fed Standard U.S. P. Thiroid Extract (Besinger)

intake due to improved appetite, but there is usually a true loss of introcen. There are no striking changes in the partition of the introgen in the urne. The consumption of oxygen may be increased 70 per cent. The temper, are rises, the pule r rise is mercised, there is nisually a striking loss of will, that to the disapperance of the mixedematon makes of fit. The entire metabolism is brought buck to the normal level or raised algorith, above the normal. The skin approaches the normal, sweating which is usually entirely all ent in mixedium, becomes possible. The hair grows a, in near-transform rippers the bowds become regular the mentil condition is much improved. These changes be, in in three to form weeks with the usual doses of thyroid.

The first invadematous patient treated with thyroid extract h. Dr. Murray beginning 1801, died in 1)20. During these twenty nine years



It 4C—Crowin Cures of Four Normal (o tent Papelly The Ab olute Cretius and Ni Absolute Cretius Trunslised Papeltedly with Representation blood Serim (Ba  $n_{\rm o}$ er )

the patient enjoyed ordinary good health and the maxedema was kept under control by continuous thyroid feeding

The marked changes in the kin in each of invivodum i produced by the administration of thiroid have led to the extensive trial of this substance in other abnormal conditions of the skin

Thyroid Feeding in Gondations of Mild Hypothyroidism—In addition to the above conditions in which there is obviously severe thyroid deficiency there are a number of conditions of hypothyroidism of a less severe type. But it must be admitted that the despisais of hypothyroid in a borderland cases' is at pre in tery insection. No direct states that many cases which have been treated for anomal ethior six scrofula ucrousne and distribunces of men trustion sem to him clearly to be accessed through deficiency. He also calls attention to the case in which

children show retarded growth with no apparent cause. The favorable results following the administration of thyroid make the diagnosis of the condition clear. Many of the cases of mild thyroid deficiency show, according to Kocher, very definite symptoms, among the most marked of which is a feeling of inhibition preventing the subjects from accomplishing that which they desire. They are incapable of continued effort, such as reading, writing, and even speaking, they become shy and avoid society. They are indifferent to food, and neglect going to stool. Kocher states that improvement follows the administration of thyroid in sinch cases.

Kocher mentions many other symptoms duc, as the effect of thiroid treatment appears to show, to slight thyroid deficiency. Among these are futigue from slight certifon, although muscular development is good, slight swelling, of the evelids, lips and cheeks, tendency to obesity, and the appearance of local accumulations of fat, swelling of the joints, so that patients frequently state that they suffer from gout or rheumant m, paresthesia, especially feelings of stiffness. Sometimes the skin has a vellowish tinge, suggesting chlorosis. Prigmentation of the skin is frequent, resembling that seen in pregnancy, the pigmentation in the latter condition may be due to relative thyroid insufficiency. The pigmentation often disappears under the influence of thiroid. Kocher raises the question whether the effect of the thyroid in such cases may not be due to an effect upon the subtractuals or other organs of internal secretion.

Further changes in the skin and its appendages, upon which kocher lays much emphasis, are drvness and coldness, with little tendency to awcating, the dryness of the hair and its tendency to fall out, the tendency

of the nails to crack and of the teeth to caries

Kocher warns against a cribing more severe skin diseases to a condition of hypothyroidism, although be states that eczema, ichthrous, etc, are especially prone to occur where the nutrition of the skin is deficient as a result of hypothyroidism

Individuals with these mild degrees of hypothyroidism are sensitive to the cold. The coldness of the skin is due to sluggish circulation, which

is also evident from the weak pulse

Nocher states that marked improvement occurs in such cases as the above within a week or tin days (sometimes even in twenty four hours) after beginning the administration of thyroid. Similarly beneficial results are stated to occur in the aged, when symptoms of thyroid hypofunction result from the gradual deterioration of the gland, and in pregnancy, when the thyroid may be unable to meet the increased demands made upon it

Various chronic diseases and intoxications (tuberculo is, alcoholism, and sometimes syphilis) may injure the thyroid, so that a mild degree of hypothyroidism results, here again thyroid medication may be of

benefit

Stoeltzner states that rudimentury forms of infantile myvedema characterized by cessation of growth, excessive fatness, etc are not uncommon, they cometimes follow infectious diseases or traumatism in anch cases, thyroid causes some improvement. Simpson reports favor able results in many cases of manufactures.

Effects of Thyroid Administration in Normal Individuals - Similar effects upon metabolism, but less marked and less constantly obtained are produced when thyroid is administered to normal individuals and to nor mal animals. The effect in normal animals is largely a question of quantities of thyroid given, and of the species man being the most sus ceptible And there are great individual variations in the susceptibility to thyroid among apparently normal persons The absorption of overen and the exerction of carbon dioxid may be increased 10 to 20 per cent although in some cases there is no increase. The excretion of urinary nitrogen may be mere seed 20 to 50 per cent usually it is less, much depending on the character of the diet. The change in nitrogen metabolism usually occurs first that in total metabolism occurs later (in the course of two to three weeks) Increased destruction of protein cannot sluays be prevented by the administration of non-nitrogenous food Hewitt reports, however, that fresh thyroid fed to adult rats in doses of 0 25 grain or less per day, lends to increased food consumption and body weight, while larger doses have the opposite effect. Large doses of thyroid or thyroxin decrease the rate of growth in young rats and rabbits, cause hyportrophy of the heart liver kidneys and adrenals (Hoskins Cameron and Carmichael) Feeding thyroid to young ribbits stimulates the bone marrow (Lim) Thyroid feeding in rats is said to produce tetany (Cameron and Carmichael), and a decreased nitrogen and ga cous metabolism (Kojima)

There is, in mm, usually a distinct increase in nervous eventability with attendant circulatory and other disturbances. Gudernatsch found that feeding, through the free distinction and the continuation of the distinction o

feeding stimulates general cell mitosis in the tadpole

No other organ has such marked effects upon metabolism and many attempts have been made to utilize these effects therapeutically

Indications for Use of Thyroid—The indications for the use of thyroid are clear in those cases in which there is a deficiency in the normal secretion in other cases. however its administration must be largely determined empirically and it must first be shown that the type of increased metabolism indicaced by throad feeding is rally beneficial in

easts where there is not depression of metholism due to thyroid deflering. The mode of action of this roid upon metholism is obserned. Some believe that it stimulates the cells directly to mercased activity, whereas others thank that the effect is primitrily upon virious pirts of the nervous system, the stimulation of which causes merciaed activity which results in in creased metholism. In support of the latter view, Anderson and Berginann state that there is no increase in the earlier dioxid output when this roid is administered to a person kept in a perfect quiet.

That excessive amounts of thyroid do mercuse nervous irritability is querally accepted on the base of observations in Graves' disease and the results of idministering large does of thind Mignal Evy behaves that there are great methodial differences, but that in some cases there is an increased methodian of the results, cells. It is evident that the solution of this problem has important bearings upon the use of thyroid to utilizate metabolism, if the thy mid increases metabolism only indicated by causing through stimulation of the nervous system, increased activity it could, for example, seried, be considered a good treatment of obesity, at least in those forms in which thyroid deficiency is not a causal factor.

Executed does of thyroid have marked effects upon the circulatory and nerrons systems, but these are of interest chiefly in councition with to toxic action of the drug, they do no suppose any the expention is for it. Eppinger, Fulta, and Rudius, or attribute many of these effects to increased irrituality of the sympulatic nerrous system. Zondek and I rankfutter state that thereof extract and iodolfarm cause brouches construction and dilatation of the long civillares.

## THEFORD OF GENOTHER SET IN OTHER CONDITIONS

Thyroid has been given in many conditions that have not yet been definitely shown to be cuised by thyroid deficiency. In some of these thyroid deficiency is merely suspected, in others thyroid is apparently used because the symptoms resemble some of these occurring in hypothyroidem. Among these conditions are virious disturbances of the skin, especially the dry scale varieties. Thus, it has been recommended in exceinity, especially that of curic childhood and of old  $a_{i,\ell}$ , it has been used in pornais, chronic urticata, pemphigus, teythooss, and sclero derma. In the latter condition the thyroid has sometimes been found attorphied (Wells)

Thyroid freatment has been tried in the tovern is of pregnancy on the theory that the intovertion is due to thyroid deficiency. This theory is highly improbable, as the syndimic of hypothyroidism does not at all resemble pregnancy tovernias.

It has been used in various disturbances of the joints, such as arthritis

deformans, pregular gout, chronic rheumatism and indefinite rheuma told pains. Among recent writers Levi and both child have especially emphasized its value in certain forms of rheumati in of children in these the thyroid is frequently enlined (Clemens). It has all o been used in cases of interame and neuralgia especially in those issociated with men trustion Thyroid has found extensive use in virious disorders of menstruction Experimental and clinical work has shown that the thyroid is necessary for the proper development of the gonids the genital organs and for menstruction Further relations between the thyroid and the female sexual armans are suggested by the more frequent occur rence of myvedoma in women after the climacteric-especially in those who have borne children—the more frequent occurrence of exophthalmic goster in women, and by the enlar ement of the thyroid during menstrua tion and pregnancy. It has been recommended in amenorrhea when other causes cannot be detected and especially at there as a tendency to obesity or myxedema. Thyroid in large doses has been u ed in celimpsia

The influence of the administration of thyroid upon the defective growth of bono in certiming sign-celed its us in divide union of frictures some writers have reported favorible results. Burther reports that the administration of throad to toning animals delayed being growth this was probably due to excess ned ose. If does not fellowe that the effect on bone growth in cretinism is specific. The appear and Swarts contrags to some, did not find that removal of the throad delayed the heiling of fractures. It has been and to have good results in rickets. Gloss proposes the theory that aribitis with accompanying distributions of the programs and the line of throad secretion which he can

siders, under normal conditions to act as a desimilaring agent

Good results have been reported from the use of the road in hemoplain. It is said that the preliminary administration of the drig, renders necessary operations (extraction of a tooth for example) safer. Such results must be doubted, for the cognitation of blood is said to be distinctly do layed in Graves disease and experimental hypertheroids in (and to be accelerated in conditions of hypotheroidsim). Frezier and Pect have recently reported the cure of a case of internal hydrocyplaths by the road administration. They were led to use this freeting it is their bloorators findings that thyroid extract decreases the rate of formation of circles possed from the results and the results are considered in the second of the results and the results are results and the results are results as a second of the results are results.

The marked mental changes produced by the administration of the road in mweedems and cretinism have led to the use of thereof in various other types of in unity, mental disturbances updays; etc. The results in cream cases of beginning melunchole in unities are stated to have been good. It is interesting to note in this connection that I very large per centage of principles with mental disc as his abnormal thirroids and that Grafe has found in certain mental disc as a true retardation of metabo-

lists (heat production 39 per cent below normal, for example) which is suggestive of a condition of hypothyroidism. Ross administered diproid to four dementia praceox patients and found an increased everetion of total nitrogen and of creatinin—this in evidence of hypothyroidism as a factor in this maled.

Space does not permit, and in many cases the clinical reports are to incomplete, to evaluate the alleged favorable risults of this purely connentative or evaluate the alleged favorable risults of this purely connents seem war unted (1) If there is in the patient sufficient hypothy roidism to induce amenorrhea, mental disorders, akin lesions, defective bone metabolism, lowered resistance to infection, etc., there must be other indubitable signs of thyroid deficiency, such as lowered lasal metabolism (2) Unless these conditions are due to hypothyroidism, administration of this roid to the e patients will, on the theory of Mobins, induce a state of hyperthyroidism and titlere is no evidence that this condition has a favorable influence on any milady. (3) There is no evidence that the augmented matabolism induced by thyroid administration is beneficial in any other condition than induced by thyroid administration is beneficial in any other condition than increasing and my vedera. Moreover, a guiertli increase in look met tolian can be induced by dietetic and hygienic measures, cold boths, ever cases, etc. (4) When the findines are baltured against the favorable results in all cases of comprised thyroid organisherapy, there is little basis left for the belief that the thyroid treatment is really responsible for the latter.

#### METHODS OF ADMINISTERING THEROID

Transplantation —The eighest attempts to combat deficiency were by
the transplantation of normal thyroid. This method has succeeded when
the thyroid is transplanted to another region of the same individual, it has
been less successful when the gland is transplanted from one animal to
another of the same species. It is, therefore, of experimental bit of little
or no practical climical importance. It has been recommended in cases
in which thyroid feeding does not produce notable improvement, as is
usually the case in endemic cretimism (cretimic degeneration). Another
states that one advantage of trinsplantation is that the body can regulate
the amount of secretion according to its needs, but that is not true of a
thyroid graft from another individual, even under the most favorable
conditions (Mauley and Marine).

Subcutaneous Injections — Murray (1891) introduced the method of treating mysedema by the subcutaneous injection of glycerin extracts of thyroid, the extracts were obtained from slicep and calve, and were preserved with phenol. They frequently caused severe local reactions. This method has no advantage over feeding the thyroid by month, but man disadvantages. It should never be resorted to Thyroxin may be given

intravenously or hypodermically but this therapy has no advantage over thyroid extract feeding, and is at present very expensive for the patient

Administration by Mouth—A very important advance in thyroid midication was made in 1802 when For Vickenzie and Howitz ilmost simultaneously announced that favorable results could be obtained in inxedema, by the administration per os of the free h or cooked thyroid. The use of cooked and fresh glands was soon practically replaced by the use of the dried glands and of various extracts. Some of these have re cited recognition in various pharmacopetas.

## OFFICIAL AND OTHER PREPARATIONS OF THURSDO

Pharmacopetal Preparations—Desected throad gland is recognized in the United States Pharmacopeia (VIII, 1905) under the name Olandniv Thyroidiv Sicce It is directed to be obtained from the sheep and to be freed of fat, and powdered one part represents approximately five parts of the freel glands Tests are included to insure the presence of todin in organic combination and the absence of inorganic todin. The average does is given as 9 25 gram, or four grains

Tablets -- At present thy rold is administered at least in this country chiefly as the dried powder which is usually prescribed in the form of tablets Such tablets are very convenient and satisfactory if they are well chewed but their use has led to the utmost confusion as to dosage Many physicians both here and abroad speak of prescribing so many tablets without, as a rule specifying either the size of the tablet or the maker, others speak of prescribing two or five-grain tablets' without specifying whether the weight refers to the total weight of the tablet (that is the thyroid plus the excipient) or to the thyroid alone, and in the latter case, as to whether the weight refers to the fresh or dried gland Others specify some manufacturers tablets' without far ther particulars How inexcusably inexact such procedures are is evident from such facts as the following Many manufacturers prepare several tablets of different sizes one firm for example lists one-half one and one half, two and one-half and five-grun, and one-tenth, and threetenths grim tablets' which of these tablets the patient received when the physician states that he administered this firm's tablets it is usually impos ible to determine

The confusion as to doogs as still further increased by the fact that different firms use different methods of expressing the amount of the rod in their tablets. Thus one firms five-grain tablet contains two grains of dissected throad another firms invegrant tablet menus that each tablet contains the equivalent of five grains of the fresh gland. One firms two-grain tablet means that each tablet is equivalent to ten Grains of the fresh throad another firm sattes that one grain of their

dry thyroid represents eight grains of the fresh gland. There can be little doubt that, when some physicians write of prescribing a five-grain tablet of dry throud, they ceally prescribe a tablet containing the equivalent of five grains of fresh throud, or one fifth of what the reader may be led to suppose

Since some "commercial" tablets contain twenty times as much thyroid as other tablets and since some preparations of thyroid are four times as active as others, there is a possibility of one "tablet' being equal, physiologically, to eights other "tablets" 3

Extracts and Other Preparations - In addition to the above, there are a number of extracts and other preparations of the thyroid on the market The term extract is frequently applied to the dried powder, a practice often leiding to confusion

Thyroidin Merch -- Reference to this preparation is frequently made in the literature. It is dried theroid I grun of which is convalent to one fresh sheep thyroid of medium size one part represents about six

parts of the fresh alaud

Thyroidin Notkin—This is a preparation of the proteins of the thy roid strated to be especially useful for hypodermatic injection. The dose per os is one sixth of a gruin hypodermatically, 15 minims of a 5 per cent solution

Thyroxin (Lendall) - This is minificatived under Dr Lendall's direction by Squibb It is a crystalline substance continuing 0, per cent nodin. The do e is one or more milligrams depending on the degree of hypofunction of the patient's thyroid Squibb also puts on the market a form of the room not completely purified

Untoward Effects and Contra indications - Untoward effects not in frequently follow the medicinal use of thy road. There are however, great individual differences in susceptibility Children are stated to be less sensitive than adults, patients with myredema as well as with toxic goiler are usually hypersensitive. This applies also to experimental cretins

Among the milder symptoms reported from overdoses, the longcontinued use of smaller doses, or in especially sensitive individuals, are flushing with increised sweitin, fullness of the head with pilpitation of the heart, tachverrdia and ingine c pain in the heart, dispute funtness, dizziness, loss of appetite, los of body weight, etc. Such symptoms have followed the tiking of two grams of the dry powder Other symptoms are names counting and severe diarrhea. Fonlis reported a case of profuse fatal diarrhea following the first dose of one-fourth of a lobe of thyroid in twenty four hours Glycosurna often occurs Marked

The above remark applies to the tablets on the American market. Equally great confusion prevails in regard to other tablets on foreign markets thus mone case a 1 ram tablet contains on fourth of a medium area thirond of a sheep

nervous disturbances may occur In addition to the palpitation etc, there may be great restlessness and sleeple-suces irritability tremors, puns in the back and estimates and vicen delirium. The temperature is sometimes elevated. Urticaria and other disturbances of the skin may occur. Great camenation long-continued debility and incima have been reported, the urnne may be dimini hed, lithough, as a rule thiroid has a directe action. As a rule these antiward effects subside within a few days after stopping the thyroid treatment but Kricker reports that he has seen emaciation tachycardia and excitement continuing for a year after the administration of thyroid to patients with Crives, discuss. This was in all probability not due to the thread therapy.

A large number of recodents one of them fatal have occurred from the use of thyroid in obesty. It is especially dametrous to obest patients with a tendency to cardinac or northe dicess. It is if o contra indicated in obest patients with a tendency to diabetes.

#### SIMMARY

1 Thrond organotherapy is definitely estallabed in all conditions of hipothy routism that is in all degrees of cretinism and invection. The administration of the entire glound substance (dried) by mouth in doses that must be determined for each individual pritent in the best method of procedure. This therapy must ordinistill be continued indivinitely. We should insist on chemical and physiological standardization of the thrond products.

3 Because of the present uncertainty as to the cause and algorificance of the thyroid hyperplass in toric goiter and the not infrequent occurrence of toric goiter and nix define in the line pitient at the same time thyroid administration has be tried experimentally in the c conditions, expectally in the very early and in the later stages. But Howard

believes this use of thy roid extract should be discourined

3 If we assume, with Uohans that an excess of throad exection in the blood produces the untoward symptoms of toxic poter it follows that un increase of thyroid exection above the normal is injurious. Hence on this generally accepted theory it is evident that thyroid administration is contra indicated in all conditions not due to throad deficiency, for Is giving throad in such or extra perbubly increase its concentration above the normal in the body fluids and the trance. The results obtained by thyroid organisherapy in various diseases other than hypothyroidism do not appear to justify further clinical empiricasis in that direction find welf-controlled laborators tests have established new those of titted.

4 The various theories ascribing to the thyroids specific inhibitory or simulating functions on other endocrine organs other than through the general lady metal dism, have so little bisss in fact that there is no justification for thyroid administration in cases of supposed hyperactivity or hypo-activity of such organs, or in supposed general disturbance of internal secretion equilibrium

#### THE PARATHYROIDS

Physiology—The parathyroids, like the thyroid gland, develop from the epithelium of the embronic gill arches In min and most mammals the parathyroids are either imbedded in the thyroid gland or lie doe to the thyroid cap ule. There are usually two purs of parathyroid glands in man and mammals in general, but accessors parathyroids are frequently pre-ent in the thyrans, and associated with accessors vodules of thyroid tissue both in the neck and the chest. The glands were discovered by Sandstrom in 1880, but their specific role was not recognized by physiologists and clinicians until a much later date. Because of the situation of the parathyroids in or on the thyroid gland, complete the roidectomy involves, in most mammals, also complete parathyroides, in most mammals, also complete parathyroides of the thyroid gland, complete the characteristic syndrome developing is a result of pirathyroid extirpation as for many years erroneously ascribed to deficiency of the thyroids

The striking thing is the relatively small amount of total parathyroid tissue in animals, and the serious effect that develops promptly on the extripation of the glands, at least in many species. Histologically the parathyroids are made up of columns of epithelial cells, without the acm or colloid so characteristic of the thyroid gland. Vincent and his papils have reported that on extripation of the thyroid she parathyroids develop into typical thyroid structure. Vincent has adduced other evidence in support of his theory that the parathyroid glands represent an embryonic state of the thyroid. But Vincent's experimental results have not been substantiated by other investigators. It is certain that in the rubbit complete thyroidectomy does not cause the parathyroids in assume the structure and function of the thyroid gland are the context of the thyroid and the parathyroids is further shown by the absence of iodin in the parathyroid gland. The earlier workers who reported todin in the parathyroids were not careful to evolude traces of thyroid tissue. This is practically impossible if one uses the parathyroids that are embedded in the body of the thyroid gland.

While it is generally assumed that the parathyroids produce an internal secretion, this theory rests on a very slight foundation of facts. It is a fact that complete extirption of the glands leads quickly to the development of grave or fatal symptoms but we do not know how the hying parathyroids privent the toxemia of tetany.

Externation of the Parathyroid -- Practically all that is known of the functions of the parathyroids has been learned from the extirpation of these glands in animals and man The typical symptoms in animals are as follows There is a latent period of several (twelve to forty-eight) hours in which the only symptoms may be a loss of appetite some in creased thirst, and a condition of hyperpritability of peripheral nerves Then appear general unrest and fibrillary contractions of various muscles especially of the tongue and jaws these become more frequent and are accompanied by a stiffness of the extremities and clouic contractions of groups of muscles The clonic contractions then extend to all the muscles leading to the typical tetamic attacks which are accompanied by salivation and increased cardiac and respiratory activity and in most animals a rise in temperature. These attacks are succeeded by a condition of pros tration during which the dysonoic respiration gradually returns to normal The animals may apparently completely recover but within a few hours or a day or two, new attack, develop and death occurs. In dogs the duration of life after complete removal of the parathyroids rarely exceeds ten to fourteen days

If only two or three parathyroids are removed there may develop a condition of latent tetary in this case there are often no symptoms except under special conditions. Among the influences provoking atticks of tetury in such animals are the occurrence of rut pregnancy lactation violent nerrous and mir cubic evertion, constipation high protein dict. The administration of various possons (phosphorus, amines etc.) miv

also provoke an attack

The rate of development and the head degree of the increased excitability of the motor neurons following parathyroidectom; in the dogare not appreciably influenced by ubtain of the certical motor cortex spinal transection, or section of the dorsal nerve roots. The increased excitability is therefore, probably due primarily to some direct chemical action on the motor neurons.

The course of the parathyroid tetany is not appreciably influenced by ablation of the motor cerebral cortex or by rendering a limb atonic

through section of its afferent nerves

As the epileptic sparms or tetame attacks following remotal of the parathy road glands do not develop posterior to the spinal tran ection it would seem that the actual tetam depends not only on the local increase of motor exitability in the spinal cords but also upon nervous connetions with some region of the enceph-don below the cerebral cortex (Mustrad)

Wilcox found that removal of one to two or three of the paratheroids in dogs may induce, more or less permanent hypereventability of the nerves but no tremors or teamy even during pregnancy or lactation but it is significant that the nervous hypereventability becomes more justification for thyroid administration in cases of supposed hyperactivity or hypo activity of such organs, or in supposed general disturbance of internal secretion equilibrium

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The hunger contractions of the empty stomach in parith roudestom and days are deprised in direct proportion to the severity of the tetrny. In extreme tetrny, the empty stomach is atomic and dilated. This is probably a factor in the charieters the amony was of tetrny normals.

The condition of the dage tive tract in experimental presidence of great interest in view of the various types of tetany of gistro intestand origin in man. While it has been known for a lone, time feeding, meat to paratherodectonized juinual least us and intensifies the tetan evaptonis, and that stars it in it rands and diminishes the tetan symptom, it is invertible a probable that the get tro intestinal supploms of paratheroid tetans in animals are munits the effects of the tetans toximis and not the primary cuss of the tetans surfaced.

Parathyroid Tetany and the Liver - 1be injurious iffects of protein food and the manes etc. A group changes in the black and in the mone gluco urin acidosis increase of immonia and amino neids in the urine reported by a number of observers in terms animals have naturally directed attention to the liver Carl on and Jucil on called attention to the marked unilarity of parathered terms the tetrms of ammonia interceation and the nervous hyperexcit dulity produced by meat feeding in dogs with the blood shinited past the liver into the general circulation by the Fek fi tuly | There is some histok neal evidence of livir degenera tion in animals dying in tetany and in the clinical tetany of pregumes (erlampsia) there apps ir al a to be instances of liver involvement. But extensive investigations on tetany dogs have failed to disclose any pri mary liver depression of importance except a dimini led ceretion of bile and this is probably due to the condition of the digestive tract rather than to the absence of specific paratheroid screetion. Put Drigstedt hi re cently shown that parathyraideetomized dogs in which the approximate of tetany is presented by suitable diet phosphorus or guanidin adminis tration in quantities having little or no effect in normal immals causes violent tetans

During parathyroid tetrus there is no change in the sugar tolerance (Stoland Murra) the everation of ammount and ammo aeids in the urine is normal or less than normal in civil tetaus (Wilson Sterms and Januey) the blood fibrinogen is normal or greater thru normal. This formation of fibrinogen is one of the functions of the liver hence the use of the blood fibrinogen is one of the function of the liver hence the use of the blood fibrinogen is a test of liver function. But massimch as the secretion of bile is decreased a functional liver test depending, on exerction of prigments in the bile would probably disclose erroneously a liver depression in tetany animals. Of course it is obvious that when the tetany condition has rendered the animal moribund the liver will be depressed along with the entire or, mism. This is of n's significance

marked during pregnancy, and especially during lactition. When all the parathyroid tissue is removed in the do_os the hyperevertability of the peripheral nerves is in evidence one to three days before the appearance of tremors and tetany.

In some cases of parathyroidectomy, enclosing and depression appear at the very onset without any evident period of nervous hyperexitability. This is priticularly frequent in eats. The eacheria and depression is usually recomputed by subnormal temperature. Practically all animals that survive the violent attricks of tetany and pyrevia die in cacheria and depression.

Extripation of the painthyroid causes, on the whole, a more violent and ripidly fital tetany in the carnivors than in herbivors, and in the latter group the adult animals are frequently less affected by loss of the

parathyroids than the young animals

Parathyroid Tetany and the Digestive Tract—Pirathyroid tetany in dos sis accompanied by gistro-intestinal disorders, anoncyar, somiting diarrhei (instilly), pain in the abdominal reson, and in the inajority of cases hyperenia, hemorrhages and ulcers of pyloric and diadean minose. The hyperexutability of the peripheral nerves in dogs in parathyroid tetany is usually, but not always, shown by stimulation of the phrenic nerves by the action current of the heart.

Tally, and Kahin describe cases of tetame contraction of the stomach

in human tetany. There are no spasms contractures or other evidences of hyperexcitability or tetany of the neuromuscular mechanisms of the digestive tract in parathyroid tetany in eats and dogs. Lien in very severe totany the movements of the stomuch and intestines may be normal, the deviation from normal is in the direction of depression or paralysis The gastric and pancreatic digestion in tetany may be normal, but it is usually retarded. The retardation may amount to practical fulure of digestion. In very exceptional instances there may be acceleration of the gastric motility (cats) The retaided digestion is not due to the absence of appetite secretion or to splanchnic inhibition, it is probably due either to direct action of substances in the blood on the digestive glands (secondary effects), or to altered activity as a direct effect of the absence of the parathyroid secretion. In the eve of other sympathetic and auto matic mechanisms (cervical sympathetic, pilomotors, sweat nerves, the uterus, the bladder, the sphineters), the deviation from normal activity in parathyroid tetany in cats and dogs seems also to be in the direction of depression

In cats and doos Kecton found a dummished scirction of gastric juice duran, parathroad tetans, and the juice contains less than the normal amount of pepsin and hydrochloric acid. The unpairment of the gastric scirction is on the whole, directly proportional to the everity of the tetany. Stoland found that the quantity of the part

creatic pince and the lide scented is also greatly diminished in terms

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the urnue of tetany dogs. Injection of the e-subtances into animals indices symptoms similar to partitive detains. But there is no evidence that there is sufficient concentration of guaindin in the blood to induce the tetuny in parathroidectomized dogs. Lung biological feets several observers have reported an interesed totust of the urne of tetany inimals.

Wilson, Steams and Jannes and that after parathyroidectomy there is a primary alkalous, or greath increased alkalinity of the blood and that seidosis is a secondary effect of the evere tetamy owing to the formation of seids as a result of the mit unlar contraction. These observes solvince the theory that the alkalo is site primary factor in the tetam and support this view by the fact that Living of alkalis increases the tetamy, while administration of acids decreases the tetam. The reader will result that MacCullium found similar support for his theory of primary calcium deficiency in the fact that calcium injections decrease the tetamy aymptoms temporarily. Acids as well as calcium salts depress the nervous trisures but this drug action does not prove the primary relation of alkalis excess or calcium deficiency to the genesis of parathyroid tetamy.

Several investigators (Grant and Goodman etc.) have recurily reported the production of a temporary tetrus; in man and animals by exce size lung ventilation (forced by utling) this reducing the earbon dioxid of the blood and presumably increasing the alkalis. But these findings do not explain printhyroid tetany. Lecording to Greenwald the tetany following forced respiration is due to the excess sodium ions in the blood. Dilleinlith has reported tetany toxins in the thymus (feed ing, thymus to taboles)

Temporary Control of Experimental Parathyroid Tetany — Some of the carliest investigators of the phisology of the printipriod (Lusena Vassalt General Moissay, MacCallum) reported that the tetany could be checked by the injection (subsuitancous intraperational or intrivenous) of emilisions of the purulivroids favorable results were allo reported from the feeding of the gland Berkeley and Betle report that the active part of the gland is the nucleoprotein fraction this was said to be efficient when given by the mouth but much more so when given absent incously

The tratment of parathyroid tetus, by the administration of the parathyroid glands differs in important particulars from that of myx redema by the administration of throad. The effect of thyroid is strictly specific, no other gland inbatance will relieve the symptoms. It has been found, on the other hand, that parathyroid tetus, can be temporarily checked, at least in the early stages by the administration of salts of calcium magnesium strontium and burnum by the injection of salts of calcium childred solution by the injection of acades by injection of extracts of the thyroid the thyrois the pancreas the testes, and the hypophysis, by the injection of motive or preptions by the injection of protects of repetiones by the injection.

The question of importance is whether there is any evidence of liver de pression that can account for the genesis of the tetany itself. Such liver changes have not yet been demonstrated.

The Blood in Parathyroid Tetany -The literature on this most im portant phase of parathyroid physiology and pathology is conflicting MacCallum and Voegtlin reported a marked acidosis, with a decrease of the calcium salts of the tissues and the blood and an increased exerction of calcium in the urine. None of these results has been confirmed (Cooke) But Marriott and Howland report a decreased calcium content in the blood of spismophilic children Berkheim, Stewart and Hawk report a case of probably complete parathyroidectomy in a man, with slight retention of calcium sails. In later experiments MacCillium re ported that transfusion of the blood of tetany dogs through the leg of a normal dog rused the excitability of the motor nerves of the transfised leg of a tetany dog, while transfusion of normal blood through the leg of a tutany dog reduced the excitability of the nerves of the tetany leg. It does not appear that Dr MacCellum controlled the temperature factor of the transfused blood Fever blood will, of course, raiso the excitability of the nerves, by the temperature factor alone Yoshumoto reports that the blood of dogs in tetany, as well as solutions of guanidin, increases the irritability of the sciatic nervo of the frog

In connection with the theory of calcium deficiency on the course of tetany, it is interesting to note that Thompson, I eighton and Swarts, and Morel have reported that it rumitism of bone prevents tetany from removal of the parathyroids, it does not, however, prevent the development

Peterson, Jobhng and Eggstein report a diminution of the serum the blood and an increase in the non-corgulable nitrogen and protoses of the blood and an increase in the aminointrogen at the length of the tetany Cooke and Greenwald report an increase in the undetermined urne nitrogen. According to Greenwald there is a marked retention of phos phorus after purally rotoctomy, and this is accomputed by retention of sodium and potassium. But in the quantities present the sodium or potassium phosphates are probably not sufficiently toxic to be the agent of the tetany.

Greenwald also showed that vanthin and mosinic acid are not the toxic agents, for there is not enough of either of these substances in the blood or tissue of tetany animals to cause symptoms, although intra eions injections of large amounts of xanthin cause convulsions. The significance of the phosphorus retention in partity roid tetany is as yet in explained, but the work of Erdheim and others indicates that chronic paratily roid deficiency leads to impairment of bone growth

Hoch and Paton, Findlay and Burns report that there is an increase in the exerction of methyl cyanids, and truncthylamin, or guantim in

Present has shown that parathyrondectoms in dogs on a diet of milk lectors and bra do or dextrin does not lead to tetans or death and if this diet is kept up from four to six weeks the ordinary meet diet (in moderation) may be restored without inducing tetrns. The above duet changes the intestinal first in dogs, from the normal parterfective to an acative type. This diet is not invariable successful in preventing tetans and munitaning life after partthyrondectoms in pregnant bitches. This indicates that the fetus (and possible the placental) is a source of tetrny towns. The e clearent experiments on non-pregnant dogs, earn to show that

1 The tetrax is due to exogenous texts and these texts are developed by the intestinal protective Born uting mainly on the food protein (meet)

2 The parathyroids in dogs are not neces are for life. After the initial dicture control of the neutre simptoms the dog come quite normal, even on a must dict. This nay be due to in increased tolerance to the titus toxins or an increased destruction of these toxins by other organs in the leafs.

3 The dogs are not normal. They are in the condition of latent tetany or epilepsy so that con tipation ixecsive incestion of meat, rut, pregiment, por ons, or excitement induce totally attacks of varying weight.

Inchkardt has shown that purathyrodectomized dogs (pregnant as well as non pregnant) on a ln_b ment duct can be kept free from tetraw (1) by a daily feeding of large quantities of calcium lactate (about 1 or per kilo body weight) for from four to five weeks after the opera ton and (2) by maintitiming a bit k diurcis for a corresponding period by means of intrivenous injections of large quintities of Ringer's soliton or all solution. After four or five weeks both the calcium and the diurcis therapy can be dispensed with the animals live indefinitely and about the contraction of the contraction of

the bars of rapid climination of the tetany towns by the kidness. The intervening action of erlemin lattice when given by mouth is less readily understood. Calcium lectate, intracenosity will not save a parathree tomacd dog from death in fact given in this way the salt produces nephritis. The bings does so fit he alt increasivy per or is a further indication that the mechanism is not that of milina, up a cleaning deficiency in the its was. The celetium may set in the gat by modifying the action of the intestinal bacteria, or fiving bacterial towns.

of hypertonic sugar solutions, by the administration of anal natrate, etc. In does the early attacks of paratheroid teture can usually be decreased or presented by giving the animal a cold bath, reducing the parent Transfusion of normal blood into paratheroid tetams does decreases the tetan; but little and does not lengthen the life of the animal

Administration by Mouth -Gram, paratherends by mouth appears to be entirely useless in the hands of later investigators (MacCillian and logtim Marme) Marme gave as mins as one imadred fresh para the roids per day to do s with complete tetans without uncharition of the symptoms or prolongation of life but transplantation of even a single purithered from another species controlled the triany for a few days, or until the gland was completely absorbed

All these measures have so far proved to be only temporary pulliatives Their action is complicated by the spontaneous periodicity of the symptoms in the early stages of the discuse and by the complete and spontaneous recovers in some individuals. The efficiency of these meisures varies indirectly with the stage of the cacheria and the severity of the excitation symptoms. The action of all these therapeutic measures can probably be accounted for in decreased excitability of the nervous tranes. The excitability is deere seed derectly by the drug action of the cilcum and the strontium salts and by hypertonicity indirectly by substances or measures that cause partial amount of the brain through sasodilatation (tissue extracts illumoses unal nitrite stimulation of the depressor nerves) None of these measures has therefore any specific significance as regards the cause and nature of paratheroid tet me

In most of the experiments the administration of the above substances has relieved the aumptoms of tetany only the animals dyin, later in cacheria. The cases of complete recovers are probable due to haper trophs of accesors glands or to gradually acquired tolerance to the tetans toxins. Thus a durable as the administration of the gland or in rections of salts of calcium may be in checking the symptoms of tetans and in prolonging life, it is open to question whether it is possible to restore normal conditions in complete parathyroidectoms, except by successful implantation of a living gland

Transplantation of Glands - For the complete relief of paratheroid insufficiency transplantation of the glands is the only effective measure, but the results have been disappointing (Halsted Teischner and hehler, landors Marine and others) Halsted concludes that transplantation succeeds only when a parathyroid deficiency has been previously induced and that parathyroid tissue transplanted in excess of what is urgently

required by the organism does not live Permanent Control of Parathyroid Tetany in Dogs -It has been found that parathyroid tetras in dogs can be permanently controlled by duet, durrests, and feeding of calcium luctate

Dragstedt has shown that parathyrodectoms in dogs on a diet of milk, lacto a and brief or dextrin does not lead to tetans or deith and if this diet is kept up from four to six weeks the ordinary meet diet (in moderation) may be restored without inducing tetans. The above dut changes the intestant fibra in dogs from the normal particlature to an acidizing type. This diet is not invariably necessful in presenting tetans and maintaining life after parathroadectoms in pregnint bitches. This indicates that the fetus (and po sibly the placints) is a source of tetany towns. These clear-cut experiments on non-pregnant dogs, earn to show that

1 The tetury is due to exogenou train and the e toxins are developed by the intestinal proteolytic flora acting mainly on the food proteins (mert)

2 The parathroods in dogs are not necessars for life. Meer the mutual dietury control of the acute symptoms the dog scenas quite normal even on a next deet. This may be due to an unerce and tolerance to the team towns or an increased de truction of these towns by other orgums in the body.

3 The dogs are not normal. They are in the condition of latent tetany or epilepss, so that constitution excessive time tion of meat, rut pregnancy powons, or eventement induce tetany attacks of varying severity.

Luckhardt has shown that parathyroidectomized dogs (pregnant as well as non pregnant) on a high must diet can be kept free from tetrny (1) by a duly feeding of large quantities of calcium lactite (about 1 gr per kilo body weight) for from four to five weeks after the opera ton and (2) by maintaining a brisk duriesis for a corresponding period by means of intravenous my choos of large quantities of Ringer's soin in n or salt solution. Miter four or five weeks both the calcium and the duriesis therapy can be disperted with the animals live indefinitely and show no tetrny except under the same conditions as stated in Dragstedt's experiments. Ill of Iuchkardt's parathyroidectomic ed dogs that have litted for a year or more have developed entaract.

Juchkruft's duress experiments can be most readily explained on the basis of rapid climination of the tetany torins by the kidness. The life-sating action of cilcium lactite when given by mouth is less readily understood. Cilcium lactite intraciously will not save a partity recommed dog from deeth in fact given in this vay the sail produces rephrits. The hige doces of the silt necessary per or is a further indication that the mechanism is not that of making up a calcium defection in the tissues. The calcium may act in the gut by modifying the action of the intestinal bacteria or fixing before rule towns.

The work of these two intestigators has greatly advanced our analysis of parathyroid function and parathyroid function and parathyroid function and parathyroid fund parathyroid fund in a single sing

Parathyroid Deficiency in Man—The clearest cases of parathyroid insufficience in man are those in which the clands have been more or less completely removed or injured at operation on the thyroid Cases of this character are not uncommon, especially from interference with the circulation of the glands. The symptoms of postoperative terms in man are very similar to those described in animals. If death does not occur in a short time a chronic condition of latent teturs or of sublictanic hyperathyreosis (Hallted) develops. Such a condition may continue for years with chronic necrous hyperexcitability (Lrb, Chrostek and Trons scau signs), the pittent having attacks of tetury at irregular intervals.

Another form of tetany, in which a condition of parathyroid insufficiency may crust is that which occurs in pregnance or lactation. At other times there may be no exidence of tetany. This form is strikingly like that observed in parathyroidectomized animals, it has also been observed in women after operation on the theroid (Frank). Krabbel reports the case of a girl who for seven years hid tetany only during menutruation, she was completely relieved by the implantation of parathyroids into the tibia. Cases are also reported in which cottus induced tetange convilions.

Another form of totan the ettology of which is still obscure, is that of children A number of writers have reported finding exten ive homor rhages into the partitive and glands in this condition. Others, however, state that such incorrhages are comparatively common in infants, and meintain that these are found as frequently in children who do not show tetran is improved a first parathyroids have been reported in cases of sudden death, with spasms of children (Grosser and Betke). Haskins and Ger stenberger found no evidence of parathyroid involvement in infantile tetrany.

Attempts have been made to bring tetany of gastro intestinal origintoric tetany, and those forms associated with various nervous diseases, into relation with the parathyroids Parathyroid chefenen, has been suspected as a factor in paralysis agitans myotoma congenita invocious, chorea, osteomilaens, rickets, celampsia, and idiopathic epilepsis, but nothing conclusive has as vet been demonstrated. Greenwald studies on the blood of paralysis agitans do not support the theory of parathyroid genesis of this disease. According to Cornby some types of idiocy are due to parathyroid deficiency

Spontyneous atrophy or hypertrophy of the parithyroids in man have not been definitely established, but they probably occur especially with age Gjestland reports hyperplasa of the partithyroids in Parkinson's disease Roissy and Clumet report parathyroid hyperpla in in paralysis agitans. Bergetruid and others have reported parathyroid hyperplasia in chronic nephritis

Parathyroid Organotherapy — Liforts to control the tetany following the removal of the parathyroids or the effects of interference with their blood supply by the administration of parathyroids have met with no citain success. Helst of states that in a patient suffering from subtetime hyp parathyroids mas the result of two operations upon a large goiter, tetany had for three years been averted and the status parathyrocoprise made endurable by the feeding of parathyroids by theyotermic injections of the nucleoproteins of the parathyroid gland and for almost one year the administration of calcium lactate. At the beginning any dried beefs parathyroids were given every three hours the effect was almost matantaneous and most marriclous. The doe was then reduced to one gland three times daily further reductions could not for several waks to borne. Later freeb glands were substituted these were more readily taken than the dried ones.

Brahlam used subcutaneous injections of emilsions of beef para throad with success in a case following operation for gotter, the tetany disappeared permanently after a second injection. It is evident that this

patient would have recovered without the parathyroid treatment

Schneider reported a case of postoperative telany an which the ad

ministration of the dry parathyroid of the horse (6 02 grim in two days)
was followed by improvement the symptoms later reappeared bit dis
appeared after 0 03 grain of parathyroid. Other favorable reports have
leen published by Bircher Rossitsky, and others. Eschrich, Frankel
Hochwart Pineles Rensburg and others report negative results from
parathyroid therapy in human parathyroid tetany.

Several cases have been reported in which relief or eure of post operative tetany followed transplantation of the gland Lenchure and hobiter obtained only temporary rehef from transplantation in one case and no results in another. They suggest that in some of the apparently successful cases in transplantation in main there was a regeneration or recovery of function by the remnants of parathyroid tissue of the patient

Parathyroid has been administered with inconclusive results in a number of other forms of tetany vad in other conditions, the influence of suggestion has not always been climinated. Hiskins and Gersten berger obtained no effects from parathyroid and calcium administration in one case of infantile teats.

684 Ition,

Berkeley relieved the symptoms of gastric telany by the administration, by mouth, of firsh ber parithronds, Mofinit also reports favorable results from the use of the dried powder and latter from hypoderane injections of the nucleoproteid of berf parathyronds.

Locwenthal and Wichrecht obtained good results from parathyroid feeding in infantile tetany, but others have reported entirely negative results

Berkeley reports better results from the administration of parathyroid in paralysis agitans than from any other remeds. Of twents six cases trusted, five were not benefited, three showed temporary improvement, and eighteen grew progressively better during the whole period of treatment Romssy and Climic observed alghit temporary improvement in two cases, a distinctly had effect in two others, and no effect in a lifth case. They report a condition of paratheroid hyperplasia (whether primary or secondary not determined) in this disease. Oppenheum recommends the administration of doses corresponding to 0.00 grain of the fresh gland several times a day.

Favorable results have been reported from the use of parathyrod in celampsia, opilepsy, idiocy, and chorea—especially in adults (Garavini). It will be recalled that several clinicians have reported favorable effects from the use of thyroid extract in cellinguia, on the theory that this type of tetany is due to theroid deficiency (Nicholson, Sturmer).

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### SHMMARY

1 Parathyroid deficiency in main and experimental animals leads to chronic nersons hypervertability, occasional tetany, and some cachexia fotal loss of the parathyroids he disto death in from two to fifter a data in tetany or extreme cachexia capically in carminorous animals. The primary disturbance following parathyroid ablation appears to be due to a toximus, primarily of the intestinal (putrefaction) origin, and recumulation of toxic protein derivatives in the blood

2 All therapeuts measures that temporarily reduce the exeitability of the nervous system will diminish or prevent parathyroid tetam tem porarily, but they cannot save the life of the patient or the eye remental animal in total absence of the parathyroids. The tetam is controlled and life prolonged indefinitely by chets that render the intestinal flora acidume, by marked dimensis, and by feeding, large quantities of calcium lactate that these surviving animals are in a state of latent tetam.

3 No definite consal relation between parathyroid deficiency and

eclamp in, infantile tetrax, gastro-intestinal tetrax, paralisis agitans, deopathic epilepse etc, has been so far e tablished. The reports on parathrond organishersyn in the e malidies are so conflicting, and in surfactors that no reliance can be placed on the few favorable results moorded. Parathyroid organisheraps in these conditions is at present purely experimental and impried.

4 The re ults to date on man and experimental animals indicate that true parathyroid tetans cannot be controlled even temporarily by giving parathyroid gland by month or by transfusion of normal blood The hypodermic or intramuscular administration of parathyroid extracts is of doubtful value even as a temporary me isure, and animal experiments how conclusions that such administration fails to prevent death in terms or cachesia in the total abone of paritheroid. In light of our present experimental and clinical experience parathyroid transplantation is the most promising therapy in all types of parathyroid deficiency, while duct durrests and hime talts per or merch control the conditions The extremely conflicting results of parathyroid organotherapy both in man in I animals, are probably due to the frequency of accesors para theroids so that alleged complete paratheroidectones is in many cases. only partial parathyroidectons, with temporary nervous hyperexcitability and tetany symptoms According to the recurrence of Hulsted and others, uch parathyroid remnants will undergo hypertrophy and may finally meet the entire need of the originam in which case the animal or the patient recovers permanently in therapy of uch temporary tetany conditions will be successful, by post hoc reasoning although it has nothing to do with the recovery of the animal or the patient except such measures as may temporarily check the hyperexeitability of the nervous tissue

With the modern care in the roid surgery cases of definite para thread deflettney in min become less frequent. Paratheroid organ editrapy of other types of climest tetam will contribute little or nothing to incideal progress until further advances have been made in the physiolyce pathology and chemitry of the paretheroid glands. Fut the detary directe and celemin liciate therapies of Dragstedt and Linck

hardt may prove beneficial in these disorders

#### THE PANCREAS

In 1889 von Mering and Minkowski discovered that complete extired pation of the pancreas in the dog produces fated diabetes. This has been abundantly confirmed on all species of virtebrates so far investigated. The utility of Pfluger and others to show that the diabetes following removal of the pancreas is due not to the absence of the pancreas but to

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Favorable results have been reported from the use of parathyroid in eclampaia, epileps, idiocs, and choren—especially in adults (Garavini). It will be recalled that several clinicians have reported favorable effects from the use of thyroid extract in eclythpsia, on the theory that this type of tetany is due to thyroid deficiency (Nicholson, Sturmer).

Morris reports injurious effects following prolonged administration of parathyroid gland by month. In a patient with paralysis agitans the feeding produced disturbing mental symptoms and insomnia, but no improvement of the paralysis agitans.

# SUMMARY

- 1 Parathyroid deficiency in man and experimental animals leads to chronic nerrous hyperceptability, occasional tetury, and some cachevia Total loss of the purithyroids h dis to death in from two to fifteen dats in tetanic or extreme eachevia, especially in curmivorous animals. The primary disturbince following parathyroid ablation appears to be due to a tovernia, primarily of the intestinal (purfer fettion) origin, and secuminal and of two protein derivatives in the blood
- 2 All therapeute measures that temporarily reduce the eventability of the nervous system will diminish or prevent printhyroid tetany temporarily, but they cannot sive the life of the pritent or the experimental animal in total absence of the parethyroids. The trany is controlled and life prolonged indefinitely by diets that render the intestinal flora acidiare by marked dimesis, and by feeding, large quantities of calcium lactate but these surviving animals are in a state of latent tetany.
  - 3 No definite crusal relation between parithrooid deficiency and

eclampers, infinite tetams, gistro-intestinal terims paralysis agitins, shopathic cultipass, etc. has been as far e-tablished. The reports on paratheroid or, undifering in the considerage are so conflicting and un-infinites that no reliance can be placed on the few favorable results recorded. Paratheroid organisher pix in these conditions is at present purely experimental and empirical.

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# THE PANCREAS

In 1889 von Mening and Minkowski discovered that complete extir Pitton of the panerus in the dop produces fatal dribetes. This has been alundanth confirmed on all species of vertebrates so far investigated. The att implies of Princer and others to show that the diabetes following removal of the puncess is due not to the absence of the paneres. But to injury to the duodenum and the nerves connecting the panerers with the rest of the viscera, must be considered a failure. The original conclusion of von Mering and Minkowski is definitely established. The complete or nearly complete loss of the puncres results in fatal diabetes. The more recent investigations of the condition of the puncreas in clinical diabetes (Opic, Allen and others) have shown that in severe diabetes or in deaths in diabetes there is usually more or less degeneration of the pincreas, especially in the island tissue. The conclusion that the pin

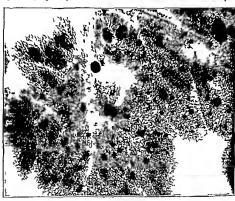


Fig. 5.—Microphotocrafic (X 28) of a Portion of the Pancrans of the Cancel of Pro Spained I than Virth by Neutral Pro This shows the normal variations of the size and frequency of the milands of Langeshame—dath areas (Bensley)

creas is absolutely essential to life and to carbohydrate metabolism is thus based on experimental and climical data, and established beyond a doubt. The part of the pancreas concerned in this function appears to be essentially the relands of Langerhans that the control of th

- 1 Loss of the external pancreatic secretion (by permanent fistula of the pancreatic ducts) does not induce diabetes
  - 2 Ligation of all the pancreatic ducts leads ultimately to complete

degeneration of all the panereas tissue except the islands of Langerhans —at ha t in animals like the rabbit and guinea pig. Such animals with only islet tissue left do not develop diabetes unless these remnants of the panereas are extripated.

3 In clinical diabetes the pancreatic lesions usually involve the islets Despite these facts the view that the entire paners is tissue is concerned in the maintenance of the capicity of the tissues to oxidize the carbohy drates is still maintained by some climicians and biologists. This view finds its strongest support in the fact that human diabetes may reach a fatal issue while there still remains an abundance of apparently normal island tissue in the paneress as determined histologically. It is possible honever that normal function is reduced or lost before anatomical or chemical degeneration of the cells reach such magnitude that they can be detected by the microscope. This theory of identity of function of the entire panciers was also supported by the work of Dale Vincent and Thomson and others which appeared to show that the islets represented only stags of fatigue or rest of the ordinary paperess tissue. Laguesse Bensley, and others have shown that this is untenable While the islets and the acini develop from the same embryological anlage (the cells of the duets), when finally differentiated they show constant and specific structural and chemical characteristics, evidently indicating specificity of function and there is no foundation for the view that the one tissue is or ean be transformed into the other

The Islands of Langerhans—The number and size of the islets rary greatly m different species, as well as in individuals of the same species. In some fishes they are macroscopie, and separated from the rest of the paneress. In man the islets have been estimated to make up one twenty fifth to one one-hundredth part of the entire paneress twice or a total of 2.3 grams. In a normal animal five sixths of the total paneress can be removed without inducing diabetics, so that the factor of safety's is very great. The total number of islands in manimals appears to be fixed at, or rather before birth (Bensley).

Lane and Bensley have shown that the island tissue is made up of two distinct types of cells, showing specific staming reactions a less abundant alpha type and a more numerous beta type According to Homans it is the beta cells that show degeneration changes in clinical diabetes

The relets detclop from the undifferentiated duct cells and may or may not retain this original connection with the ducts but in either case the blood supply of the islets is greater than to the rest of the pancreas tissue. In this respect the relets resemble the adrenals and the thyroids In fact blood sinuses similar to those of the adrenals have been described in the islets (DeWitt)

The islets are also abundantly supplied with nerve fibers (Gentes, Pensa, Laguesse) Groups of grughon cells are also distributed in the body of the princres. The function of the nerves distributed to the islets is unknown. Some of them are undoubtedly rasomotor nerves but others form a network between or around the islet cells, which appears to indicate a secretory or reflex function.

Experimental Pancreatic Diabetes — Futirpation of the whole or more than six sevenths of the pancreas leads to fatal diabetes in all animals. In birds pancreatectom leads to byper, Jucinia, eachevia, and

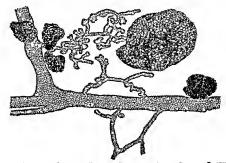


FIG 6.—PANCREATIC DUCT WITH BANCRES SHOWING THE HIGHEY BRANCHES TEXTLES CONNECTED WITH THE DUCT AND WITH AN ISLET Intra vitam struming with Lyronin and neutral red X7. (Prosley)

death but there is said to be little or no glycosuria, because of the relative impermeability of the renal epithelium of birds to sugar

Followin, the fundamental discovers of paircratic dribetes by von Mering and Minkowski in 1889 a great amount of work had been done to elucidate the nature or machinism of this diabetes (cf. Allen, 1914). The following facts are established

1 Hyperglucema and glucosuria appear within a few hours after panerestectomy and together with polympia polyhiqua and polyhipsia persist until shorth before death, eice when no food is given. If the hyperglucema of human or experimental diabetes is sufficiently marked, the sugar appears in the saliva gastric and principality in the bile (Carlson and Ryan Pearse.)

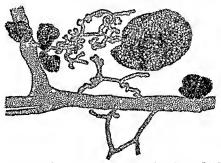
2 The liver and the miscles become prictically free from glvogen, but the essential factor appears not to be the mahility to store glycogen (slimentary glycosuria) but a greatly diminished capacity if not complete mability to avidue the sugar. It is of course possible that all earthohydrates must first be built up into animal starch or glycogen before oxidation, but this scenis improbable since this implies some structural differences in the glicose molecule before and after being a member of the glycogen complex and we have as yet no evidence that this is the case. The respiratory quotient is therefore low (Yurihi and kramer) Assis states that perfusion of the liver of panceritetomized turtles with Ringer a solution plus glicose leads to storice of glycogen in the liver cells.

3 There is marked polyphagas (Luckhardt) and a striking increase (I to 20 per cent) in the total metabolism per unit of bods weight (Morehouse, Patterson, and Stephenson). There is no rise in the respiratory quotient after giving glucose or fructos. The increased exerction of the acction bodies parallels the increase, in the D. A ratio.

- 4 There is usually some acidous and ketonuria, but these symptoms of diabetes are, at least in the dog not as marked as in climated inhetes and the completely panceaetectomized animals die apprirontly from extreme maintion or from intercurrent infections rather than in diabetic come due to genefosis.
- 5 When the panereas remnant is too small to maintain normal sugar tolerance and metabolism, the panereas rest is mero likely to undergo gradual atrophy than to show hypertrophy with the end result of abolite and fatal diabetes (Sandmeyer) The incomplet diabetes in animals following extirpation of more than 8- per cent of the panereas can sppsrenity be intensified, and the appearance of complete diabetes and death hastened by a liberal carbohydrate diet (Thiroloix, Allen Carlson and Jensen)
- 6 Complete pancreatectomy leads to death in from three to eight weeks, in the case of dogs, irrespective of the age of the animal (Carlson), while diabetes mellitus is usually more rapidly fatal in children than in adults rud in old recoile
- 7 The persistent hyperglicerum and glycosuma and the low respiratory quotient show that the pair-create-tomized animal huma practically no sugar yet the study of the sugar ovudation capacity of the blood and of individual tissues like skeletal muscles and the heart have so far revealed no difference between the normal and the diabetic animal (Claus and Embden MacLean McGungan Patterson and Starhing Macleod and Enden Meaclean the start with the start system of the days heart averages 071 irrespective of whether the heart is that of a diabetic or a normal dog (Starhing and Evans) But Heplum and I stehford have recently reported that adding a purplied paincreatic extract (unsulm) to the perfining fluid

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Following the fundamental discovery of parecratic dislottes by von Merin, and Minkowski in 1889, a great amount of work had been done to clinedate the nature or mechanism of this diabetic (cf. Allen, 1914). The following facts are established.

1 Hyperglycemia and glycomia appear within a few hours after part and together with polyurar polypharia and polydipal persist until shortly before death, even when no food is given. If the hyperglycemia of luman or experimental diabetes is sufficiently marked the sugar appears in the salina gastra, and pancreatic juice, and in the bile (Carlson and Ruan Peurce).

very low in the pig and the help (Carlson and Drennan Hinter and Hill). In normal per one from hindred to five hundred grains of glace of may be given by month without inducing polyuma or given may (Taylor and Holton). In normal men and minude the oxidation of sugar is in care of in proportion to the quantity of sugar given intrincipularly up to a very high limit (Woodsatt).

The endeavor to determine how abone of the poince is caused an lates as practically a record of repeated failures. The leading idea in all this work has been the internal ceretion theory or that the pancreis yields some substance to the blood in some way neces are for the oxidation of the sugar by the tissue cell. The new method of attack introduced by Calmbrian has not yielded consistent results (Claus and Imbden McGingan) and in the light of the findings of Levin and Meyer the method it cliff is allelf in question as it appears that in a mattern is finusely extract and panerias extract place e is polymerized not violated. No light on paneriate dailyters has so far been shed by studying, the sugar oxidizing power of tissue delives of issue extracts.

Elood Transfusion—If the punctus control the evadation of subtrom the tissue by a hormone or homome the must be per cut in the blood, and audies they are extremely unstable or pre cut in acry minute traces it hould be possible to inercise temperarily the sugar ovidation in diabetic animals and patients by trunsfused in it is made blood in sufficient quantities. But the results obtained by this method are both con-

flicting and difficult to interpret

Lepine reports a temporary diminution in the output in the urine, lut no diminution in the I lood sugar This would cam to point to some injurious action of the foreign blood on the kidneys-a su-gestion also advanced by Hedon-but habous has bown that transfusion of normal blood into diabetic dogs does not influence the output of any of the urinary constituents except the sugar Hess injected intrivenously 50 to 150 cc of bli oil from dialictic dogs into normal dogs (on the theory that diabetic bland might stimulate the paners is to a greater output of internal ecretion) and nine to fourteen hours later he injected the serum from this animal into diabetic dogs. The influence on the glycosuria of the diabetic animal was slight or inconstant. In view of the results of Dreinin, it cems likely that in the experiments of Hess the papereas secretion in the blood was destroyed by the delay in centrifuging the blood. Alexander and Ehrmann injected blood from the panercaticodnodenal vein of normal dogs into dialectic dogs but obtained no definite or con tant decrease of the glyeosuria

Dramm injected 0 to 1.0 cc of firsh defibilitated does blood into the curs of dialette days and in initials obtained a temporary lowering of the initial section on strinding for a few boars. The course of the blood sign

increases the glucose consumption of the excised and perfused maininalian heart

Certain other features of experimental pancrents diabetes may be noted. Epstein and Bachr claim that there is an increase in the blood colume (plasma) in dogs and cits after pincretectoms, irrespective of whether the animal is fed. Hoskins and Gimming state that in dogs after complete pancretectoms the blood pressure amounts either normal or somewhat depressed. Reaction to adrendin is usually augmented, to meetin variable but usually depressed. There is no evidence that the pancre is normally exerts a depic size action on the sympathetic persons.



FIG. 7—SHALL PORTION OF AN ISLET OF LANGERHAYS OF THE GUINEA LIG. Shows B cells filled with fine granule and i c II stuned diffus ly q i cells × 1000 (Bensley)

system They found no evidence of increase in the adrenalm con tent of the adrenals after panerentectomy

Verzar and Ferer claim that administra tion of pheese during the first three to four days after pinerea tectomy ruses the res piratory quotient This, if true would indicite that the pan ere is hormone persists the blood tissues for ecveral This is probable It must be remembered, however, that all the sugar of

the food or from the endogenous protein metabolism does not appear in the urine even in animals and pritents showing the D. N ratio of 3 55 1, which Lusk has designated as the index of ab other diabetes. It is not known what becomes of the retuned sugar. In diabetic patients "the respiritory quotient fulls to account for all the earbohydrates that disappear in the body" (Allen and DiBos)

Numerous attempts have been made to explain the giveosuria of dia betes by the increased rate of hieration of the sugar from some hypothetical singer proton or sugar colloid combinations in the blood. The dialysis experiments of Van Hess and McGingun seem to demonstrate that all the sugar in the blood is present in simple solution, that is, in free form

The carbohydrate tolerance varies preatly in different species. It is

is subsequently climinated by the kidneys as excess  $\operatorname{sign}$  as suggested by Murlin

The blood transfusion as such does not impure the kidness activity in any demonstrable way, either in diabetic or in normal days. The term porry lowering of the glycosium of parients diabetics by transfusion of normal blood is due to the diminished hyperglycemia not to kidnes injure but it remains to be demonstrated that this retained sugar is actually oxidized by the tessues

Parabiosis —I sperimental symbiosis or parabiosis of two mammals is accomplished usually by union of the kin and the abdominal walls is accomplished usually by union of the kin and the abdominal walls of two sisters or brothers. It was originally thought that such union of two animals would had to a direct va cular connection between the two, but it is now known that this is not the case. There is no fusion of the capillary systems of the two unimals in the region of the tissue union but the capillary systems of the two unimals are in so close contact that chemical substances injected into one animal soon appear in the blood of the other animal. On the basis of this fact one may responshly expect that the blood hormones of one animal will find their way into the body fluids of the other animal. On this theory Forsbach extripated the pain creas of one member of two such pirabiotic puris (dogs). In every case, a slight temporary glicosanna appeared in both sunimals. But because of accidents both experiments were terminated before definite results were obtained.

Pregnancy—It was shown by Pearce that the relets of the pancreas appear early in fital lift. There appears to be no diabetes or glecositina in buman infants bora two or three months before term. This would seem to show that the pancreas hormones become of functional importance to the fettus a considerable time before the end of gestation. On the basis of these facts Carlson, Drennin, Orr, and Gusburg made complete pan createctomy in pregnant bitches near term. In all cases where this operation is not followed by abortion the blood sugar and the urner remain normal until the pupe are born or remained by cesarian section. Complete panceratectomy in bitches in early pregnancy leads to abortion or a least to death of the fetuses in one or two weeks and the course of the diabetes is not influenced.

This absence of diabetes may be due either to the pancreas hormones of the fetuses passing into the mother's blood or to some detoxicating action on the part of the fetal punchas

There is a seeming discrepancy between these results on pregnant dogs and the usual clinical experience on the effects of pregnancy on the course of dabetes in the humar. The chinical experience appears to be maximous on the point that pregnancy augments the diabetic symptoms, and hence the practice of terminating gestation in diabetic mothers. Now, even if in their primary cause all cases of diabetes mellitus are identical

in the injected animals was not studied. Hedon has reported a very exten sive series of blood transfusions in diabetic dogs. Direct transfusion from a normal dog into a diabetic dog previously bled dry causes a temporary lowering of the blood sugar and decrease or complete suppres sion of the glycosuria but, since the same results were produced when blood from a diabetic dog was transfused into another diabetic dog, Hedon concludes that the temporary diminution of the hyper-lycenia and giveo suria following the trunsfusion was not due to any specific panerias secretion in the blood but to a lowering of the blood sugar by dilution and to a toxic action of the toreign blood on the kidneys. The results of the cross transfusion experiments reported by Hedon do not concern us here, since these may be interpreted in various ways (detoxication of the panere 14, storage of glaco, en in the normal animal, dilution of the diabetic blood ete ) Hedon also transfused (cross transfusion as well as serum injections) blood from the pancreatic vein of normal to diabetic dogs A slight temporary lowering of the hyperglycemia with a greater reduc tion of the urine sugar was noted, but the latter is interpreted as due to an injurious action of the foreign blood on the kidneys Hedon con cludes that the internal secretion of the pancrers acts on and is absorbed by the liver and is, therefore, not present in the blood of the systemic circulation Hedon attempted to obtain evidence in support of this view by introducing a living paneres in the systemic and in the portal circulation of diabetic dogs. With the living paneres interposed in the portal circulation the hyperglycemia and glycosuria were diminished, but when it was interposed in the general circulation the paneress had no effect

We do not think that these latter results of Hedon can be accepted, in view of what is known concerning the carboby drate metabolism in dogs with Eck fistula. In the animal with the Eck fistula the internal secretion of the panciers, if there is one, must pass into the general circulation, and only a small part of it can reich the liver by was of the hepitic artery, just as in Hedon's diabetic dogs with the living princreas from another dog interposed in the general circulation, yet the Eck fistula dog does not develop diabetes.

dog does not develop discovers.

Mirlin and Krimer reported one experiment with transfusion of normal blood into a diabetic dog showing slight rise in the respiratory

quotient, as a measure of sugar exidation

Carlson and Ginsburg, found that the transfusion (without anesthesia or previous hemorrhage) of normal blood into dogs in complete panceralic diabetes causes a temporary (four to eight hours) lowering of the hyper givenina and the glycosinra Similar transfusions of diabetic blood into diabetic dogs have no effect on the byperglycemia. There was no indication in these results that the singar retained by the animal in consequence of this temporary lowering of the sugar excretion by the ladders

is subsequently climinated by the kidneys as excess sugar as suggested by Murlin

The blood transfusion as such does not impair the kidness activity in any demonstrable way, either in diabetic or in normal does. The term porary lowering of the glycosums of panereatic diabetes by transfusion of normal blood is due to the diminished hyperglycemin not to kidnes injury but it remains to be demonstrated that this retained sugar is setually oxidized by the tissues.

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with that of experimental princretic diabets, the favorable action of the fetal princress on the mother would come outs late in pregnince, and the disturbances in digestion, circulation, and emotional states, etc., of the first half of pic-uanes would undoubtedly act unfavorable. Put, so far as we have been the to feart, the unfavorable action of prenancy on clinical diabetes during the second built of gestation is even greater than during the first half. If this is true, it would seem to indicate a primary difference in the citology of diabetes in may and of

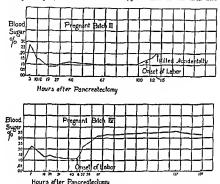


Fig. 8—Charts Showing Absence of Hyperolycemia and Diabutes after Complete I sacrentectury in Late I rednancy Diabetes being at orbeit of labor (Carl som and Ginblurg).

experimental pancreatic disbetes in other maminals. The diffuence, however, may be only apprint. If the disbetes in the mother is cuised by the depression of the prince is be some substance in the blood, or by the inhibition or neutralization of panerettic secretion. In substances in the blood rather than by actual atrophy of silet tissue, these substances in all probability would act in the same way on the fetal panereas or panereatic hormones, thus giving the usual clinical findings.

Transplantation of the Pancress—Vost of the transplantations of the pancress have been more dislocation of a portion of it, the usual method being the transplantation of the tail of the pincress with its cir

culation intact to other parts of the abdominal cavity or even under the skin of the abdomen It a sufficient quantity of the panerens is thus dislocated or transferred and care is taken to retain the circulation in good condition at least for a time the remainder of the pinereas may be extrepated without inducing diabetes (Thir dox, Hedon Lombroso Min kow ki) But in most cases even these transplants show a tendency to atrophy with a gradual onset of diabetes and ultimate death in complete dribetes. The external ferments of the pancreas are probably in part responsible for this gradual necrosis of the graft. There is no record in the literature of transplantation of pure island tissue. There is cer tunk greater hone of success with such though than with the entire pan ereas. Pfluer fuled to influence the disbetes of depanereatized frogs by inserting pieces of the panere is under the skin or in the peritoneum I ratt reports the case of one panere is autotrinsplant anto the picen (dog) that retuned its function (ab ence of directes) for six months But there is little hope of panerers transplantation becoming of significant value in clinical diabetes since it come at present impossible to keep grafts of any gland permanently functional

Feeding Panereas or Panereas Extracts—Teeding digs in complete on partial panerentie diabetes with freel panerers increa es the glyconuria and acidosis (Smidmever Pfluger Luthje Reach Rosenberg Kirk). Cooked panereas gives equally inguitar results. Teeding of raw muscle liner, or other thesic extracts his the sime uniformable influence on the glycosuria and ketonuria. Aniset and particularly I ratt. Spooner and Murphy report good effects from feeding, panerers in partially diabete dogs but the improximent in the calloholdrate tolerance was slight variable and practically negligible. According to Mas ight feeding panereis extract to guince page with experimental reduction of the panereas reduces or prevents the chiminary Ausonaux following earlohydrate food

Injection of Pancreas Extracts—Lp to the year 1921 subsultations or intraperitoned injections of extracts of the pancreas variously prepared caused temporary diminution of the glycourry in diribetti annimals (Caparelli Vanni Tiberti and Frinchetti Minkowski Hedon Zucker Sott, Allie Mirthi and Kramer and others). But this temporary diminution of the output of sight in the urine was associated with tone effects such as depression fewer ter and McGuigan showed that almost any thing which causes marked systemic depression (such 18 migetion of proteoses) leads to hypoglycemia and will thus temporaryli diminush an existing elections. The such as a superior of the such as a superior of proteoses, leads to hypoglycemia and will thus temporaryli diminush an existing elections. Thoughton and Starling and Maelean and Smedley reported that the sugar evolution of the hir of from diabetic animals is almost init, and in any event much le s than that of a heart from a normal animal but further work has shown these re ults to be due to fully technic (MacLeod and Pearce, and Patterson and Starling). Extract of the

panereas added to the perfusion solution has no effect on the respiratory quotient of the diabetic heart (Starling and Evans)

This was the unsatisfactory state of our scientific work when, in 1921, Banting and Best renewed the investigations of princers extracts, with promising results. They first made extracts of the fetal panereis, and of pinereas rendered atrophie by ligation of the ducts, in order to eliminate the external panereatic secretion. The e extracts reduced the hyperglycosuria of diabetic animals I ater, in collaboration with Collin, acid and alcohol extracts were made of the normal adult panercas that similarly reduced the hyperglycemia of diabetes and lowered the blood sugar in normal animals. The extract, or rather the active substance in the extract, has been named insulin Insulin has so far not been prepired in pure state nothing is known of its composition, although Macleod has reported that active extracts can be prepared that give no reletions characteristic of proteins The extract is toxic, but according to Macleod, at least part of this toxicity is due to the active substance, mishin, that is to the excessive hypoglycemia caused by excessive doses of the insulin The experimental results to date (January, 1923) reported by Banting, Best and their collaborators and workers in other institutions can be summarized thus

The panereas extract, insulin, lowers the blood sugar both in diabetes and normal animals. This seems to be due to two processes (1) mereased formation of glycogen by the liver and the muscles, and (2) increased exidation of engar, as shown by the rise in the respiratory This action of the extract is temporary (6 to 8 hours) 2 Continued administration of the extract seems to maintain nutri

tion and prolong the life of departreatized dogs, but the work on this place is not yet conclusive

The extract has little or no effect when given by month or per rectum It must be administered parenterally

The toxic effects (depression, convulsion, death) from large doses are assumed to be due to the hypoglycemia, since these effects can be, at least in part, prevented by the administration of glucose

The insulin does not seem to be entirely specific for the pin creas, as extract producing some hypoglycemia can be secured from other organs by identical methods of preparation But Macleod reports that, in fishes, insulin is obtained from the island of I angerhans and not from the pancreas proper

6 Some fraction of the pancreas extracts actually produces hypercheemia in normal animals (Fisher)

Pancreas Hormones in Pancreatic Perfusates -Clark placed the pan creas in the perfusion circuit of an excised heart, perfused with Locke's olution containing known quantities of glucose. He reported that under these conditions the beart consumed more glucose than did the heart without a surviving pancreas in the circuit. Clark interpreted this as proving that the pancreas secreted into the perfusate some substance that accelerated the sugar oxidation by the heart. Landes, et al. perfused the evused pancreas with Tyrode's solution for varying pariods and in jected the perfusate intravenously into diabetic dogs. There was no reduction of the hyperglycema and glycosuma. There is no evidence that the evested pancreas perfused with a lunger sugar solution is sufficiently normal to secret the hormone. Clark's results imply the explained by death and solution of the island cells. It is well known that per fusion of organs with salt solutions quickly induce pathological changes (edema).

The perfusate takes up depressor substances (peptones t) from the pancreas In order to eliminate these sources of error McCarthy and Olmstead, in our laboratory, perfused the excised pancress (using the Woodvatt pump) of the dog with defibrinated blood from the same and mal, and then injected the blood intravenously into diabetic dogs. Con trol experiments were made by perfusing the excised spleen. In other control experiments active secretin was added to the defibringted blood in order to see whether the excised and perfused panercas was sufficiently alive and normal to secrete pancreatic juice. In most esses a slight secretive response (a few drops) was obtained but this was much less than the usual response of the intact pancreas to similar doves of secretin It is, therefore clear that even when the excised papereas is perfused with blood the pancreas is so shiformal or depres ed that it is doubtful it say normal function is present. Intravenous injection of this pan creas perfusate into diabetic dogs usually lowered the hyperglycemia, but did not constantly lower the D N ratio of the urine That these were toxic rather than physiological effects seems to be shown by the fact that identical results were produced by the spleen perfusate. It would seem that perfusing the excised pancreas leads to demonstrable quantities of the pancreas hormone in the perfusate only to the extent that island cells are killed and extracted

Relation of Pancreate Diabetes in Animals to Chinical Diabetes—In their essential features experimental and clinical diabetes are practically identical. There is the same impairment of the power to hurn sugar, the identical hyperglycemia tendency to acideous lowered resistance to infection polyphagia, etc. The two types of diabetes are influenced in the same direction by diabetic and therapeutic measures (Allen). All the evidence points to the view that diabetes mellitus in man is primarily due to deficiency or inhibition of pancreatic bornones. This does not apply to the various glycosurias (adrenalin increous, alimentary, post operative, etc.) which do not involve impairment of sugar oxidation.

Administration of Pancreas Preparation (Insulin) in Clinical Dia betes by the Mouth—Some of the carliest attempts to treat diabetes mellitus organotherapeutically were by the administration of the pancreas by the mouth, it was largely abandoned very carly, for the results were practically negative (Wickenzie, Wood, White, do Cerenville, Willis, Williams, Rennie and Fraser Prutt, Wood, Murshall)

A few writers (We ole Mever, Cowles and Enstra) have reported far orable results—Some of the e reports continu only uppressions, in others the glycosuria seemed dependent upon an infection and varied so much in severity that it is difficult to determine what, if my, effect the trut ment had—In Cowles' case the diabetes had followed an abscess of the pincreas—marked and rapid improvement is stated to have followed the enting of one to six (average three) raw pancreases of ealiest daily After discontinuing the treatment the patient became rapidly werse and died as he probably would have done had the puncreas feedings been kept up

Remute and Fraser administered the islands of Langerhans obtained from fish of certain species in which they occur separately, that is distinct from the puncreus proper, to a number of diabetics, the results were no ative

Sewill found in the earlier stages of one case of vonthful diabetes that the urine could be made free of sugar by the administration by mouth of infusions of ran, lean beef followed after some hours, by one of pancreas neither alone was efficacious and after some months the combined treatment failed. The method was inflictive in a number of other cases. No good results attended the use of the commercial pancreatic powder.

Under the influence of the first report of Knowlton and Starling on the effect of painters extract on the sugar consumption of the diabetic heart, Eustia administered 10 to 20 grains of an "active extract of the paneress' every four hours on an empty stomach in four closes of diabetes. He reports diminution of the glycosuria in two of the patients and no effects in the others. The insulin of Building and Best appears to have no effect when given per os or per rectum or by means of the duodenal tube.

There is, however, according to Falta, a small group of cases of human diabetes in which the administration of pancreas by mouth gives good results this is the result of supplying the external and not the internal secretion of the gland Fulti refers to those cases in which the pancreas is diseased, so that there is no longer an adequate secretion of pancreatic pute into the intestine this occurs most frequently when there is complete obstruction of the pancreatic duet. In such cases Falta states that the administration of large doses (10 grains daily) of pancreatin gives excellent results.

pancrers vitamin to marrismic children stimulates growth and improves nutrition. This is food theraps, not or another ips

Subcutaneous and Intravenous Injections of Pancreas Preparations - I number of attempts have been made to trait diabetes by adout meons and intraperatoneal injections of extracts of pancreas with negative or injurious results. The favorable results reported by some of the earlier clinicians were hown by I fluger and by Leschke to be wholly inconclusive The more recent attempts of Zuclzer to tacit the disease by the intri venous injection of a pineress hermone was piner up lirgely because of toxic effects of the extract During the last veir the insulin of Banting and Best has been tried on selected cases of himmin diabetes in the United States and Canada It is too carls to reach definite con clusions as to the ultimate value of insuling but so in the results are encouragen. (Bunting et al.) In sufficiently lines doses three times per day (hypodermatically) insulm seem to control all the symptoms in most diabetic people and permit a larger food intake some diabetics are less favoribly influenced by menlin. These may act be eases of panerertic dubetes. The main drawback to the insulin treatment is the toxicity of the extract and the necessity of such frequent hypoderine administration Dictory control will probably always be a factor in the management of disbetes, unless insulin therapy for horter periods may increase the carbohydmte tolerance more or less permanently

Fortunately, few attempts have been made to treat human diabetes by tunnsplantation of the paners's Futcher stress that Williams of Bristol tunnsplanted the pinercaste gland of a slacep under the skin of the breast and abdomen of a duabetic. The patient die lof some in three days

Blood Transfusion —Rulston and Washatt appen to be the fire to try blood transfusion as a practical therapeutic measure in man. The patient was a man in the thirties the diabetes of several verse standing with periods of threatening comm. The blood (**00 e c) was vidiled by a two varioder bother of the patient. The experiment was well controlled. The blood transfusion augmented all the diabetes symptoms for several days following the operation.

Relation of Other Endocrine Glands and Organs to Experimental and Climical Diabetes —In 1908 I princer Filtr and Paulinger advanced the theory that diabetes is not due perimarily to the hypothunetion of any one endocrine gland (for example the princers) but to a disturbance of the hormone equilibrium of all the glands—particularly, that of the pun creas, thyroid, adrenals and hypophysis. This view is still held by some (Prown Hatar) The specific influence on eurobalvatae metabolism of hypofunction and hypertimention of the already shryoid and hypophysis are diseased in the sections on these glands respectively. It now remains are disease of in the sections on the glands respectively. If now remains are disease of the hypofunction of any other organ beside the princreas is capable of so radiacing the especials of the

tissues to store and oxidize sugar that true diabetes follows. A critical analysis of the entire literature, experimental and clinical, seems to war rant the following conclusions

- 1 Hypo activity of the thyroid, the hypophysis and the gonads may slightly change curbohydrate tolerance, although further studies should be made on this question by Woodyatt's more accurate method of measuring sugar oxidizing capacity. If true, this may be in reality a thiroid factor, as there is some indication of bypertrophy of the islets, at least after thyroidectomy.
- 2 Excessive administration of epinephrin, thyroid extract, and possibly hypophyseal extract, may induce temporary hyperglycemia and gly cosuria due to increased sugar mobilization. But there is no evidence that this glycosuria is, or passes into, true diabetes, that is lowered power to burn sugar, in the absence of a direct panners depression. This applies also to disturbances of the nervous eastern.
- 3 The precise influence of the hypo-activity or hyperactivity of the adrenals, thyroid and hypophysis on the islets of the pancreas cannot at present be definitely stated but it is obvious that organs which are as necessary to life, that is, to bealth normal life, as the parathroids, the adrenal, the hypophysis, and the thyroid will affect the vital process of the islet tissue, at least indirectly, through the general disturbance of metabolism and the circulation

After a careful experimental and critical review of the entire question, Allen states that the "polyglandular equilibrium doctrine of diribetes has consisted from the first of ingenious but unfounded speculations." We are in entire accord with this conclusion

The attempt of Pfluger to show that dubetes is due not to hypofunction or loss of the pincreas, but to interference of nervous refleves from the pancreas to the duodenum and the liver has stready been referred to. Any general reflex theory of dribetes is insteadil, in view of the fact that every organ so far investigated continues to ordize sugar after complete denervation. The loss of the sugar oxidizing capacity is, therefore, a hormone, not a reflex phenomenon. But the building up of givcogen, especially by the liver, appears to be partly under nervous control.

Other workers have pointed to the probable importance, direct and indirect, of the gastro intestinal tract in diabetes. Case has recently reported a striking parallel between the severity of clinical diabetes and the degree of ileal stass. If the ileal stass is a primary fector this would point to intestinal intoxication depressing the pancreus as a contributory factor in diabetes.

The administration of sodium carbonate reduces temporarily the glycosinna of depancer-tized dogs

This fact has led Murlin to suggest

that the diabetes following extirpation of the panereas may be due in part, to the unneutralized HCL of the stomach secretion. Murlin and beset have removed the stomach in depunceratized dogs and find that the glycosuria is less severe than with the stomach intact. But such an mals are probably more depressed than after panereatectomy alone, and the low output of sugar may be due to thus condition.

#### SHUMARY

- All the evidence supports the view that some substance or hormone secreted by the islands of Langerhans into the blood is necessary for the building up of glycogen and ovidition of suprior but tissues. This function is specific for the paneres. Other endocrine organs (adrenals through may influence singar metabolism in a superfical was by altering the sugar mobilization, or by increasing or decreasing the rate of candition in the body in general. The rest of the endocrine glands can not maintain the power of the tissues to ovidize sugar in the absence of the panereas, and the hipo activity or hiperactivity of other endocrine glands does not broduce dishetes in the pre cace of a normal nanceess.
- 2 While the failure of the tissues to burn sugar in the absence of the pancrets i the central and definitely established fact there are probably other primary defects and equally important impairments involved in the development of acidosis increased metabolism lowered resistance infection lipemia etc.

3 All the evidence points to the view that true diabetes mellitus in man is primarily the result of pancreatic (islets) deficiency, or inhibition

of the islet hormones on the tis ues

- 4 The insulin of Banting Best Collip and Mielcod may prove to be a specific and useful substance in the control of diabetes. But so far as the evidence now stands it is not a cure and the dietary control of diabetes as developed especially by Allen. Newburg and others will probably all wass constitute a necessary factor in the therapy of diabetes.
- 5 There is no evidence that the various pancreas extract preparations on the market, sovertised as active when given by mouth are of any value in diabetes.

## THE SUPRARENAL GLANDS

Anatomy—The suprarind plands of man and the higher animals consist of a teast two distinct issues. The cortex is of mesodernal origin and belongs to a system known as the interrenal system. The medulia is of extodernal origin starting as a part of the sympathetic nervous itsues. It is a part of the "adrenal or "chromaffine sistem (so called tissues to store and oxidize sugar that true diabetes follows A critical analysis of the entire literature, experimental and clinical, seems to war rant the following conclusions

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aqua) it is present in pirt of the kin and the skin secretion of this animal is reported to contain epinephin (Abel)

The suprireral gland has a very rich blood supply. According to Neumann the blood supply to the c glands is greater than to any other organ in the body, or b to 7 c e per gr um of gland per nimit. This enormous blood supply is undoubtedly of significance in relation to the secretory and possibly, detoviciting functions in the gland

Each admind gland receives numerous werse filterates from the splanding nerves and the admind places. The nerve filterates tree distributed both to the cortex and the medallal pirt of the fibers passes to the blood we sell (useomotor nerves) and pirt appears to end around the gland cells (escretor) practist). The sympthetic nerve cells are also found both in the cortex and in the medallal. Nothing is known concerning sensory nerve supply to the adrenals.

Chemistry of Medullary Tissue —Oliver and Schafer howed that extracts of the medulla of the suprarenal glands when impected intra

venously, can ed a marked rise of blood pressure

The chemical work of Abel, von Furth Takamine Aldrich Dal in Stolz, Flacher and others resulted in the isolation of and later synthesis (from coal tar derivatives) of a definite chemical compound named by Abel epinephrin by Takamine adrenalin Chemically this compound is dioxyphenylethylolmethylamin (C.II, 12 O2) It is levorotatory empound made synthetically is optically inactive and his only about one half of the physiological activity of the natural compound (Cushns Schultz) It can, however be separated into two optically active a univers one of which, the levorotatory compound orms identical in every re pert with the natural base. Epinephrin is present in all chromaphile tissues (Vincent, Tulk and Visclerd) It appears very early in the tetal adrenals at least in most species (McCord Feneur Cevolutto Linglois and Rehns) But Lewis failed to detect epinephrin in the fetal adrenals in man This is important in view of the fact that there is no evidence of adrenal in sufficiency in premiturely born infants. It epincphrin is absent in the human fetus in lite gestation (seven to cight mouths), this substance is evidently not necessary for life

It is estimated that the normal adrenils of idult persons contain at any one time only a few milligrams (6 to 3) of epitephrin (Elliott). The adrends of normal does continu 1 to 3 milligrams of epitephrin ('videnstricker'). Trendelenburg reported that the adrends of the eat secrets into the blood about 000 milligram pur minute or about o milligrams per kind body accipit in tracity from hours. Hoskins and McClure estimated the output in cputephrin in the dog is 0.2 cc of a 1 1 000,000 dilution of cpinephrine per minute per kilo body weight. The same authors found that the blood of the general circulation (deg) contains epinephrin in the concentration of 1 200000000.

from its affinity for the sults of chromic acid)  $\Lambda$  very considerable amount of chromatine tissue is found in main outside of the superansia (in small masses along the suppartition errors and in the carotid glaid) interrent tissue is also often found in other parts of the body outside of the supragraphs

These two parts are anatomically separated in some fishes, but in min and the higher immals they are so infinitely connected that it is very



Fig. 9—ACTION OF SUPERFYAR OF CHILD TWILLE DAYS
OLD LOW HOWER A outer part of corbex B large
cells forming lymidary zone of cortex C thin layer of
medulla just below is the central vein (Elliott and
Armourt)

difficult to study their functions separately, and most of the know ledge on this subject is bised upon ob erritions and experiments upon the entire organ Acce sorv supi trenils (medullary tissue, or cortical tissue, or both combined) occur in some unimals, par truthally the rat

The cortex is made up of polygonal opithehim like cells ar ringed in columns and rich in a double refractive lipoid substince. In the pig this lipoid makes up 38 8 per cent of the dry cortical residue (Bitell)

The fetal adrenals are relatively large, it one stage the cortex extending throughout

the whole length of the body custs. The femule rat hus a lurger adrenal glind than the mile. In other species such sor differences have not been made out but there appears to be some hypertrophy of the adrenal cortex as occuted with the periods of rut and pregning. In man there occur and agreed the total of minimition of the adend cortex during, the first two weeks after birth (Lews and Pappenheimer). The modified norte cells of the medulity portion are claracterized by their brown color is uttom with throme acid (chromophile relation). This chromaphile tissue has been found in certain parts of the nervous system and in the skin of virious inactificities. In the American total (Bufo

- 2 The quantity of epinephrin in the blood sufficient to raise the blood pressure or to affect the blood pressure is more than sufficient to in libit the mothity of the gastro inte und tract. In fact the gustro in testinal tract is more sensitive to the inhibitory action of epinephrin than the heart and the blood vest list not store or simulation action. Hence as long as gastro intestinal mothity is present there is not enough epinephrin in the blood to influence the tone of the heart and the blood uses its.
- 3 Complete or practically complete suppression of epinephrin secretion by section of the adrenal nerves does not induce lowering of the blood pressure or unpairment of the beart
- 4 The minimum effective do e of epinephrin causes a fall not a rise of blood pressure

Emergency Theory of Adrenal Function—This theory was proposed by Cannon in 1914, bused parily on data already in the literature parily on work by Cannon and his as securities. This theory assumes that under conditions of marked physiological stress such as pain anger fear other intense emotions, asphyria, etc., then, is a sufficiently interessed secretion of epinephrin to have physiological and useful action for the survival of the animal. In support of this theory Cannon musters the following arguments.

- 1 It seems well established that hypodermatic or intravenous injections of suitable quantities of epinephriu stimulate the bear raise the raterial blood pressure increase the coagulability of the blood mobilize the liver glycogen in the form of increased blood sugar increase the regulatese to fatigue of the skeletal neuromuscular mechanisms increase the coagulability of the blood, and induce a temp vary polycythemia.
- 2 It is also established that direct stimulation of the peripheral end of the splanchine nerves causes sufficient augmentation of compiler out put to have demonstrable physiological effects (rise in blood pressure dilation of the pupils etc.)
- 3 That simulation of the sciatic (pain) asphyvia anger, etc., acts on the epinephrin secretory nervous mechanism in the way of stimulation Cannon and his coworkers Amrep and others, have tried to prove by the behavior of the denerated heart under these conditions before and after aderanlectomy, all o by direct essay (intestinal strip) of the epinephrin content of the blood by vasconstriction in the denervated leg by the r. action of the denervated pupil and by increased sceretion in the denervated salivary gland. Some of these tests were made without anesthesia, and the reported results indicate that scattle stimulation (pain) asphyxia and string genotions cause increased secretion of epinephrin

Stewart and Rogoff have repeated or checked all of these experiments both with the original methods and with improved methods of their own

burg states that the epinephrin content of the carotid blood of the normal rabbit does not exceed one part to two milliards of blood. Stewart and Rogoff give the following figures for the aterage rate of epinephrin secretion (animals under light anesthesia) per kilo body weight of animal cat, 0 00025 milligram dog, 0 00025 milligram, monkey, 0 0002 milligram, rabbit, 0 0003 milligram.

Epinephrin is a rather unstable body. It is oxidized or destroyed only slowly in the blood, but rapidly by the tissue and the walls of the blood vessels (Tatum). Hence, giving epinephrin by mouth is prac-

tically without physiologiesl effects

Tonus Theory of Adrenal Function—It seems well established that the suprarenal glands under normal conditions secrete epinephrin into the blood of the adrenal veins continuously and at a remarkably constant rate It was formerly supposed that enough epinephrin is thus secreted by the normal adrenals to maintain a steady stimulation of, or tome action on, the



FIG. 10 -- EFFECTS OF INTENTENDUS INJECTION OF ADSERVAL ENTENOT (EFFRESHRIK) ON THE HEART AND THE BLOOD-PRESSURE (Oliver and Schafer)

heart and the blood vessels, thus aiding in the maintenance of the normal blood pressure This constituted the so-called tonus theory of adrenal function The work of Cannon, Hoskins, Stewart, and others has rendered this tomis theory untenable, for the following reasons

1 The quantity of epinephrin secreted into the blood under ordinary to blood vessels Hoshins found that it requires 0.42 cc of a 1,000,000 epinephrin per kilo body weight per minute to affect the blood pressure in the dog and this minimum quantity causes is associatation not is construction (Cannon, Hoshins) The normal output of epinephrin by the dog's adrenals is only 0.2 cc of this epinephrin concentration per minute. The maximum concentration of epinephrin by the dog's adrenals is only 0.2 cc of this epinephrin concentration per minute. The maximum concentration of epinephrin and Rogoff). Even assuming that there is no destruction of epinephrin until it reaches the systemic capillaries the dilution of this substance in the arterial blood will be 1 500,000,000 or 1 1000,000,000.

normal (Bedford and Jackson) Stewart Rogoff and Gibson found that massage of the suprarenals increases the secretion of epinephrin

Anesthetics including morphim decrease the epinephim content of the glands (Graham), presumably through a preliminary increased secretion. But depression of the rate of building up the secretion in the gland may also be a factor. The epinephim content of the glands is all o greatly decreased in many infectious discases especially the acute infections such as peritomits (Elliott, Reich, and Berenegwiski kindley and others). But there is no evidence that epinephim deficiency is a factor in the debility and prostration of acute infections. Pellegrim states that the amount of chromaffin tissue is reduced by structure. But Jackson, McCarrison and others have reported bypertrophy of the adrenals in starvation and after vitamin poor diets. Thyroid feeding is said to induce adrenal hypertrophy.

According to Ott and Scott and Gley and Quinquad extracts of pin creas liver, thyroid, thymus gonads kidness, pituitary parathyroid ete, eause an increased output of epinephrin. Evidently this is a torus action of protein split products in the treast extracts acting via the viasomotor catter and the splanchine herics, and possibly directly on the medullary cells. It is of no significance in the relation of these organs to the nor mal work of the suppracials.

Dale and Elliott have suggested that some of the general systemic actions of alkaloids like mootin and pilocarpin, and the anesthetics (mor plus, chloroform and ether) are indirect effects due to the increased out put of epimephrin caused by these substances Strichina and serm in crease the epimephrin output Nicotin decreases the output The reports

on pilocarpin are contradictory

There appear to be no seasonal variations in the epinephrin content of the adrenal gland (Seidell and Fenger)

Pharmacological Actions of Epinephrin—howhedge of the details of the pharmacological action of epinephrin bas increased greatly within the last few vears and it is now possible to express nearly all the facts in the form of a general law the peripheral effects of epinephrin are in most cases essentially the same as this so of the stimulation of the sympathetic susceral efferent nerves to the itssues unolved. The peripheral action is upon the 'myoneural junction which is a part of the 'receptive substance' (Langley) of the cell. In sufficient concentration epinephrin acts also on the central nervous system. It also acts on peripheral mecha almsi in which sympathetic innervation has not vet been demonstrated.

The following illustrations show some of the applications of this law

Blood vessels — The very great use of blood pre-sure following the intravenous injection of large doses of epinephrin is due largely to a peripheral constriction of the blood vessels especially of those of the but failed to secure any evidence of reflex (pain), asphyxial or emotional stimulation of the adrenal medulla

The theory has thus far no unchallenged experimental support Even if future work should prove the theory tenable, it must be shown that animals with denervated adrenals are handscapped in their natural en If that is not the case, the reaction may have no greater biological significance than the blushing that may or may not follow the

feeling of embarrassment in some people

Theory of Epinephrin Control of Functions of Blood Capillaries -Extensive studies on dogs, cats and rabbits led Gradinesen to conclude that the suprarenal secretion controls metabolism by controlling the permeability of the blood capillaries, and hence the exchange between the blood and the tissues He claims that adrenal deficiency can es the blood plasma to pass into the tissue spaces and the body cavities to such an extent that the concentration of blood-corpuscles becomes twice as great as the normal The viscosity of such blood is obviously great and the circula tion correspondingly impeded. But it is possible that the transudation of plasma from the blood noted by Gradinescu is in reality an effect from the impaired circulation (cardiac edema) But Donath maintains that change in capillary permeability is a factor. This theory should be reinve tigated in the light of the recent work of Krogh and others on the nervous and chemical control of the blood capillaries

Secretion of the Epinephrin - Direct stimulation of the splanchnic nerves increases the output of epinephrin (Biedi, Dreyer, Cannon, Elliott and others) It is generally assumed that this is a true secretory action of the adrenal nerves on the medullary cells. But the stimulation of the splanchnics causes at the same time vasodilation of the suprarenals while it is well known that this stimulation induces va oconstriction in all the other abdominal organs innertiated by the splanching nerties. It is not known whether the increased blood flow through the glands by hormone action increases the epincphrin output. We have seen that the view that painful sensory stimuli, intense emotions, and asphyxia increase the out put of epinephrin has been denied by Stewart and Logoff on the basis of a series of careful experiments. It would seem that some of the work of Elhott, Cannon, and others, was not adequately controlled

Richards and Wood report that stimulation of the depressor nerves leads to a decreased output of epinephrin, they interpret this as a true reflex inhibition of the action of the secretory nerves Pende claims that section of the splanchnie nerves leads eventually to atrophy of the medulla This is probably erroneous

Surgical and traumatic "shock' reduces the epinephrin content of the glands to only a fraction of their normal amounts (Corbett) Shock in duced by hemorrhage or manipulation of the viscera increases the epi nephrin content of the blood coming from the glands up to thirty times the on some parts of the gut depends on the state of tonus of that part at the time of application of epinephrin. For example if the mammalian cardia is in strong tonus, epinephrin causes inhibition if the cardia is a feeble tonus, epinephrin causes contriction (Carlson)

Urmary Bladder —The same relations held for the bladder as for the alimentary tract in those animals in which stimulation of the sympathetic causes relaxation of the hladder and contractions of the irrethral opinephrin

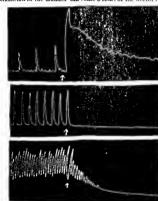


Fig. 11—4. Stitutlation Effect of Epirephikin on the Rabbit S Uteads. (Hagali.) B Immirror Epirot of Epirephikin of the Uteads of the Pat. (Hagali.) C lumbror Epirot of Epirephiks of the Cat. S Intesting (Young).

does the same, when stimulation of the sympathetic is without effect upon the bladder, epinephrin is also without effect

Uterus —Îhe effect of the epinephrin npon the uterus is determined by the character of the sympathetic nanervation. It like the stimulation of the sympathetic, causes powerful contractions of the pregnant uterus and of the non pregnant uterus in certain animals. In the virgin uterus of the cat however both epinephrin and stimulation of the sympathetic cause relaxation. Dale was able to demonstrate the presence of a sympa-

splanchnic area The constructor muscles of the blood vessels are in nervated by the sympathetic (visceral) nervous system In organs (for example, hrain) in which the sympathetic vasoconstructor innervation is but slightly developed (or, according to some writers, aheent) epinephrin has but little (according to some, no) vasoconstricting effect (cf Wiggers)

The minimum effective dose of epinephrin always causes a primary vasodilatation (Cannon, Ho kins) This appears to be, at least in part, a central action, that is, stimulation of the central vasodilator mechanism or inhibition of the constructor mechani m (Hartman) All strengths of epinephrin appear to cause dilatation of the arteries in the skeletal muscles This action of epinephrin on the blood capillaries is essentially the same (both dilation and constriction) as on the arteries, but some capillaries are refractive to epipephrin, despite their sympathetic impervation (Krogh)

The vasoconstricting action of the drug is seen when it is applied to a mucous membrane or to the abraded and bleeding skin, the structures be

come blanched and hemorrhages from small vessels cease

Heart -Extracts of suprarenal and epinephrin can e a marked accel eration and strengthening of the heart beat, the effects are the same as those of the stimulation of the secelerators (sympathetic motor nerves) The maximum rate reached is the same as the maximum rate after stimulation of the accelerators, this rate may be maintained for some time by the repeated injections of small doses (Hunt)

In the intact animal the acceleration of the heart is frequently (almost always, if the do e is large) prevented, at least at first, by a simultaneous stimulation of the vagus centers, the latter is attributed in part to the high blood pressure, but there is some direct action of the epinephrin both on the vagi centers and on the respirators centers (Brown, Nice and

Rock)

The Coronary Circulation - Epinephrin contracts the coronary ve cels in man and the monkey, but in other mammals (dog cat rabbit, ox, beep, pig) it dilates the coronary tessels (Barbonr and Prince) The e dif ferences are probably due to the character of the sympathetic innervation

of the coronary vessels

Alimentary Tract -The effect of epinephrin on the alimentary tract is on the whole the same as that of the sympathetic nerves. When the lat ter cau e inhibition epincphrin does al o, when the stimulation of the sympathetic cau es contraction epinephrin does the same. Thus in the rabbit, epinephrin causes relaxation of the entire alimentary tract with the exception of the pyloric, ileocecal and internal anal sphincters which contract under its influence. The action of the sympathetic nerves on the alimentary tract varies in different species of animals, the effects of ennenhrin vary in a corresponding manner

But the primary action (be it stimulation or inhibition) of epinephrin

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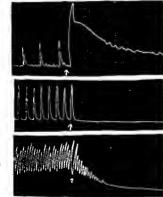


Fig. 11—A Structation Expect of Epirephens on the Rabbit 5 Uterus (Hingaki) B. Inhibitory Eppect of Friverheit of the Uterus of the Rat. (Harak.) C. Tyrindton Eppect of Friverheit on the Cat's Intesting (You.g.)

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But the primary action (be it stimulation or inhibition) of epinephrin

actuary But it is difficult to see bow this is possible on the hasis of the relation of the adrenal veins to the ladney arteries. And in the general arterial blood there is not enough epinephrin present to act on the renal arteries.

Metabolism—Epinephrin has little effect upon nitrogen metabolism except in maintion, when it is said to merease protein metabolism. This effect is attributed by Epineper, Falla and Rudinger to a stimulation action upon the thyroid. Recent work in Boothby seems to show that pempehrin increases temporarily the bead metabolic rate. Cannon has reported that intravenous injections of epinephrin induce temporary electrical changes in the thyroid gland, which he interprets as due to merasid throad activit. But there is no antisyoustic action of the thyroid glands to epinephrin glycowina as determined by the reaction of the animal after extripation of the e-glands (Blum and Mark). Wolfe and Thatcher found the introgen metabolism normal in a case of Addison s di easo. The endogenous metabolism as represented by creatinin and unre-acid, was below normal.

Epinephrin has a marked effect upon the giveogen sugar mobilization in the body. This appears to be due to the stimulation of certain sympisthetic nerves (Tatum). The epinephrin glycosuria is accompanied and caused by a hypergiveenia and a diministion of or disappearance of glycogen from liver and miscle. The degree of glycosuria is largely determined by the amount of glycogen in the liver, although some excretion of sugar

is caused in starting animals

Tuelzer Embden and others have found that when epmephrin is added to blood used in parfusing an excessed liver, it causes the latter to liberate eugar into the hepithe ven in far greater amounts than when normal blood is used. The above facts lead to the conclusion that the action of epinephrin in producing glycosina is due to a setting free or mobilization of the sugar stored as glycogen.

It must be noted however, that the above effects of large doses of epunephrin intravenously on glycoepolyte are strictly speaking strefects. There is no evidence that such amounts of epinephrin are under any conditions put into the blood by the glands in the intact animal. The specific antagonistic action of the suprareal and the pincreatic secretions on sugar metabol in advanced by Falta and others has proved to be erroncious (Main and Drips). Epinephrin administration does not affect the oxidation of the sugar in the body (Lusk). Epinephrin deficiency causes no permanent change in errbohydrate tolerance (Crowe and Wislocki). The failure of pancreas extripation to cause dirbetes after previous adrenalectomy in some species is due to the low blood pressure and the morphoid condition of the animal (McGugan).

Epinephrin in certain concentrations (intravenously) increases the coagulability of the blood (Cannon and Mendenhall) In larger doses the

thetic inhibitory supply to the uterus of other animals also. After very large doces of ergot, which paralyze the motor nerves, stimulation of the sympathetic or the administration of epinephrin causes relavation of the uterus in all cases. The conditions are analogous to those which hold for certain hlood vessels.

The action of epincphrin upon the uterus is one of the most delicate tests for the drug (Frankel's test), a solution containing one part in twenty millions is active

Bronchial Muscles—The effect of the epinephrin upon the bronchial muscles is of special interest, since it appears that attacks of bronchial sithma in man are temporarily relieved by it. This suggests the presence of sympathetic inhibitory nerves to the bronchial muscles, but attempts to demonstrate their existence have been unsuccessful. Similarly, efforts to demonstrate an action of epinephrin upon the broughtal muscles have usually failed. Eppinger and Hess, however, behave that epinephrin may, through the stimulation of sympathetic inhibitory nerves, counter act the contractions of the bronchial muscles caused by increased vagus tonus. Januschke and Pollak found that it relaxed the bronchial muscles in muscarin asthma and had some relaxing effect on normal animals. In frogs and salumanders epinephrin inhibits the hypertone lung musculature by peripheral action. In tirdes and suckes the central lung motor mechanism is inhibited by small doses, larger doses depress the lung musculature by peripheral action. (Carlson and Luckhardt)

Action on the Pupil — The intractions injection of epinephrin into animals causes the same changes in the eye as follow the stimulation of the cervical sympathetic nervo, namely, retraction of the intentiating incidentate and of the eyelids, protrission of the eveball, and dilutation of the pupil (through stimulation of the dilator musele). Instillation of epinephrin into the eye is far more effective in causing dilutation of the pupil when the superior cervical guighon has been extripated than it is in normal aumals (McItzer and Auer), this revection has been intilized in locating the site of injuries to the cervical sympathetic (Cords, Sebleau, and Lumaitre). Solutions of epinephrin applied repeatedly to the normal human cyc cause dilutation of the pupil (Schultz and Wessley). Slight lesions of the cornea greatly freshtate the reactions, Cords has used the reaction to detect enseues and nleers of the cornea.

The pupil of the frog seve (either in situ or enuclented) dilutes upon the application of very minute amounts of epinephrin Meltzer and Auer suggested that this reaction might be used for the detection and estimation of this substance. The reaction was elaborated by Ehrmann as a test for ennephrin

The Kidneys —According to Cow, epinephrin passes directly into the blood of the renal arteries and by its local vasoconstructor action diminishes the rate of urine secretion, thus acting as an important control of kidney

are extrasted in one operation. I like treports that complete extrapation of the adrenals in the cat leads to death with low blood pressure. fall of temperature and great depre son of visomotor and cardial accelerator nerves. But Hoskins and Wheelon state the visomotor system and the visomotor little are unumparted at a time when marked asthemia of cardiac and skeletal muscles is in evidence. Hence there is no evidence that the sympathetic system suffers primarily in my degree from adrenal extirpation. In cats adrenal ectons, reduces the hisal metabolism about % per cent (Aub). This reduction sets in within a few hours after the operation. But non lethal injuries (highestic investigal) are said to induce a definite but temporarily increased heat production and this does not occur if the thyroids are removed previous to the adrenal injury. (Marine and Baumann, Scott)

Injections of epinephrin do not increase visomotor irritability (Hos kins and Rowley) Complete ligation of the adrent blood vessels leads in a few hours to a distinct fall of blood pressure, but this is no evidence that this fall is due to lack of epinephrin according to McGuigan and

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Pierry and Vallossel and also Porges have reported a condition of hypoglycuma after adrenalectomy. But this is probably not specific for an condition that induces a marked general depression is necompanied by hypolycemia (McGiugan). Porges found hypoglycemia in three cases of 4ddison's disease. The reduced amount of sugar in the blood has been held to explain, in part the most striking symptom following the removal of the suprarenals—the asthema. Favorable results in Addison's disease are reported from the administration of sugar (Pitres and Gautrelet) Animals deprived of their suprarenals are cassiv fatigued. If forced to evertase they may dis suddents. But that would probably be true of animals sequilly moribuid from other curves.

Crow and Wislocki report enlargement of the lymph glands in adrenal insufficiency. Lower and Geltwert et it that the blood of cold blooded animals from which the advantals have been removed is toxic. When applied to the heart the heart stops in distole, evidently by sugus stimulation as the toxic action is abolished by atropin. Whipple and Christman state that adrenal deficiency lends to impairment of the liver as determined by the phenolphthalein test. This is probably an indirect effect of impairment of the circulation.

The questions as to which part of the suprirenal system the interrenal (cortical) or the adrenal (includingry), or both are essential to life, has been much debated some authors have considered that only the former others that only the latter is essential to life. All the evidence points to the cortex as the essential part but if there is any truth in Gradinescu is theory of epinephrin control of capillary permeability, it is evident that

the medulia is of some importance

congulation is delayed. According to Caunon, adrenalin also acts as a stimulant to the skeletal neuromuscular mechanism, and he interprets this as due to a direct action of epinephrin on the muscle, but this has recently been questioned by Schafer. The improved circulation and the mobilization of the blood sugar may be the factor in delaying fatigue after large epinephrin injections. Epinephrin induces vasodilatation in the skeletal muscles (Hoskins, Gunnier, Berra).

Functions of the Adrenal Gortex—Concerning the role of the adrenal cortex we have a number of theories, but very few facts. No internal secretion has so far been demonstrated. Whipple has obtained an extract from the cortex having a printrinlike action on the circulation. The abundance of hipoids in the cortical cells has led to the suggestion that the cortex clubratts these for the use of distant organs. It has also been supposed, without evidence, that the precursors of epinephrin are elaborated in the cortex. In the absence of a definite internal secretion of the cortex, theories of detoxiciting functions have been advanced.

Cortex Essential to Life — All the evidence, experimental and clinical, to date, points to the cortex rather than the medulla as the organ essential to life (Bield, Scott and others). In nearly complete adrenalectoms only the cortical remnints undergo hypertrophy (Orowe and Wislocki)

The most striking correlation of the adrenal cortex appears to be with the gonads Estrus (mule and femile) pregnancy, lactation, and gonadectomy are in some species accompanied by increase in cortical substance Tumors and hyperplasias (hypernephroma) of the cortex may be accompanied by precocious sex developments (secondary sex characters) both in the male and the female (Jump, Bestes and Bahcock, Baldwin and others). But these relations are not of a direct and compensatory character. For the adrenuls full to maintain sex life after gonadectomy, and the gonads fail to maintain hie itself after adrenalectomy.

the gounds fail to maintain hife itself after adrenalectomy

Extingation of the Suprarenals—The removal or destruction of both
suprarenals leads to death within a few hours or days (Brown Sequard),
exceptions to this rule are due to the presence of accessory glands Beddescribe, the effects as follows for one or two days the animals seem to
be entirely normal, on the second or third days the animals seem to
be entirely normal, on the second or third days the animals seem to
be entirely normal, on the second or third day there is loss of appetite,
afterward aprithy and muscular weakness become apparent, the movements
become stiff and uncertain Then great prostration follows, the animal
is unable to rise, and hes extended on its abdomen. There is a marked
fill of temperature (to 30° C or under), respiration is labored, the heart
is irrigular and weak the animal usually dies (in one to three days)
in this condition of parilysis. Occasionally there are muscular twitch
ings, more rarely convulsions Gradinescu states that after complete
udrenalectomy rabbits die within seven hours, dogs in ten and cats within
forty five hours. Removal of one udrenal has no effect. On removal of
the second adrenal the animal usually lives longer than when both glands

adrenia betrays a profound ignorance of modern suprarenal physiology, and a remarkable civalier attitude toward the emons of logic (Colioc)

Unin attempts have been mide to correlate exiting conditions of high blood pressure with hypertrophs of the suprarenals especially of the medulfa, but it is not certain that the suprarenal changes are primity nor has it been shown that there is an excess of epinephrin in the blood (Stewart)

Control of Experimental Adrenal Deficiency—Efforts to overcome the effects of the removal of the suprarenals in animals have been made both by the administration of the effend and its extracts. Notitier has so far met with success. In no case, has his been prolonged for more than a few hours after the administration of the gland to animals from whom the suprarenals have been removed. Considerable improvement in the symptoms (increase of blood pressure improved respiration) has frequently but reported from the substitutions or intrivenous impetion of extracts of the gland but the results did not drifter from those observed in animals near death from poisons and other causes. Excling adrenal tas suc, fresh or dried may be a failure due to the de truction of the hypothetical cortical hormone in the gut. The only actuate of hope in this field seems to be in fracturation of the adrenal cortex for hypoderime administration.

So far, transplantation of the suprarenals has been successful only as a preventive measure, that is it is possible to prevent the characteristic effects of the removal of the glands by the pievons transplantation of a gland (Buth) Apparently, when the effects of the removal of the glands have become manifest it is not possible to delay duth by the transplantation of the glands of other animals. Hoskins reports that rata fed on drued adrenal glands for two to mue weeks showed by pertrophy of ovaries and testee, but no change un other or_non in growth or in guntral condition.

Organotherspeutics in Suprarenal Deficiency in Man—iddition a Disease—Addison's disease is the only condition in man in which a suprarenal manificancy clerity custs and most of the interest in the organotherapeutic use of the suprarenals centers around it. The results are essentially negative.

Other Conditions of Supposed Suprarenal Insufficiency — Suprarenal glands and epinephrin have been administered in a number of conditions in which an insufficiency of the glands had upon inconclusive evidence, been supposed to be present. The results have been inconclusive.

It has been supposed for example, that a condition of suprarenal in sufficiency crusts in many throme diseases especially tuberulous and the administration of the gland, or of epinephran recommended accordingly It has also been recommended in neurasthema associated with low blood pressure. It has found extensive ms. in the cardiovascular exhaustion of acute infectious diseases. In this condition, however it is used as are

Disease of the Suprarenal Glands -The first important contribution to the knowledge of the function of the suprarenals was the classical paper of Addison (1855) on the disease which bears his name. The disease is characterized by a condition of muscular and cardiac weakness, usually with a low blood pressure, a subnormal temperature, apathy, disturbances of the digestive trict (comiting, diarrher or constipation finally asthema), pigmentation of the skin and mucous membranes, and a progre sive cachevia almost always ending in death. There may be periods of spon tincons but temporary improvement. Ticken reports a case of apparently permanent (two years) recovery from Addison's disease. All the features of adrenal disease in man are reproduced by adrenal extirpation in animals except the skin pigmentation. This may be due to the speeds fatality of complete adrenalectomy, it evidently requires more time for effecting the change in skin pigmentation

The typical anatomical change found in the suprirenals in Addison's discase is a tuberculous degeneration. The chromaffine tissue in connec tion with the sympathetic nerves, outside of the suprarenal glands, has also been found involved in a number of cases, in others the chromaffine tissue both in and outside of the suprirenal glands was apparently intact It is practically certain that Addison's disease is due to impairment of

the adrenal cortex Absence of epinephrin has been found in a number of cases of Addi on s discuse (Oliver and Schafer, Luksch, Ingler and Schmorl)

Studies of other abnormal conditions of the suprarenal glands in man have only been suggestive of possible functions of these organs. It has long been known that in many cases of congenital malformations (anen cephalia, hydrocephalus) the suprarenals show a condition of hypoplasia or of aplish In some of these cases only the medulla was involved, the cor tex being normal. The relations of these conditions whether casual or not, have not been definitely determined On the other hand, excessive growth has been reported in cases of tumors of the suprarenals

Hypoplasia of the suprerenels has been met in a few cases of retarded sexual development, and in cases of osteomalacia and status lymphaticus On the other hand, hypernephromas originating from cortical suprarenal tissue have, in a number of cases, in infants and young children, been associated with sex precocity, and in the case of girls with development of male characters-such as masculine hair on the face

Hypo adrenia and Hyperadrenia - During the last twenty years an increasing number of disease symptoms (depression, asthenias, etc.) has been referred to a diminished output of epinephrin. This chapter in medicine is a serious reflection on the knowledge and common sense of the medical profession There is no evidence that hypo adrenia (too little eninephrin) exists except after denervation of the adrenals, or that if it does exist it could produce disease (Stewart) 'The literature on hypo

an effect when given subcutaneously as when given intravenously. Intra musular injections are much more efficacious than subcutaneous ones

Epincphrin also differs from most alkaloids (Straub) in that it does not accumulate in the tissues and that it is quackly destroyed in the body, it exerts its action only during its pissale, into the tissues and, hence, its action depends upon the difference in the concentration in the tissues and in the concentration in the blood rather than upon it as ablinic amount Moreover, its effect does not become its after repeated administration, the hundredth injection for example causes as great a rise of blood pressure is does the first and subsequent injections

The above considerations indicate that the best results when the drug is used as a cardiovascular stimulant are to be expected from the continu own infusion of a west solution. This conclusion coincides with climical experience. Although hife has undombtedly been temporarily saved by in translatedlar or intratenous injections of computatively strong solutions (4 mainus of the 1 1,000 solution for example) the best results have been obtained by the continuous injection of a solution of 1 20,000 or 1 100 000 in normal string whition.

Epinephrin is quickly absorbed from the lungs and Amer and Gates suggest its administration by intratracheal sufficient in cases calling for a sudden sumulation of the heart.

The n o of this drug as a cardiousscular stimuluti has proved useful in conditions of cardiac and vasomotor failure under ane thesis (general and spinal), in shock and sents hemorrhage and in cives of poisoning (as by chloroform and chloril) although very t two able results have also been reported in the low blood press ure of pneumans and other acute in fections diseases—especially of children. In diphtheris it is said to relate prostration and asthema saids from its effect on blood pressure Rolleston administered it by the month in 10 minim doses of the 1 1000 solution every two to four hours secondary to the vereity of the attack

solution every two to four hours according to the exercity of the attack. I aswen and Sievers state that in certain conditions of stoppage of the heart the injection of 0.2 cc of the 1 1000 solution directly into the

heart is permissible

The greatest field of usefulness of epinephrin however is as a local hemostatic

It is used to cheek epistaxis and also hemorrhages into the rectum (hemorrhoids) bladder [100 cc of the 1 10 000 solution, for example) uterus etc and to relice conjection of the conjunctive and of the mucous membrane of the nose (as in rhinitis and law fever) and of other organs

It has been used in postpartum hemorrhage, it not only constructs the blood we als, but causes a contraction of the muscle fibers of the uterns

It may be applied in solutions of from 1 1000 or 1 20,000 either directly or on cotton, or as a spray, or in ountments cavities such as those

other cardiovascular tonics, that is, it is used as are other drugs, and not as an organotherapeutic agent in the usual incrining of the term

The suprarenal gland, and especially epinephrin, has been used extensively in osteomelacin. The views as to the value of this mode of treatment (proposed by Bossi) are conflicting, some report fivorable results Novak for example reports seen cases treated by subcutaneous injections of 0.5 to 1.e. of the 1.000 solution. Three were improved, in two there was a slight diministration of the bone pains at the beginning, and in two there was no effect.

Attempts to deduce a rational basis for the use of suprarenal mosteomalician have been made from the following facts. There may be some untigonistic (or supplementary) relation between the orderies and the suprirenals the latter hypertrophy when the former are ramoted or artrippine, and also in pregionen when prits of the ovari are phisiologically quie exit. Christofoletti has advanced the hypothesis that in osteomalicia there is a hypofunctioning of the observed in the chromatine tissue due to a hypofunctioning of the ovaries. Is was pointed out above, however, in discussing the relation between suprirenals and the sex gluids, the cortex seems to be the part of the former which is clueft uncolved, whereig, in the tretiment of osteomalicia, a product of the medulla (epinephrin) is usually employed. The favorible results which at times seem to follow the use of epinephrin in osteomalicia are probabile due to other factors.

Certain writers have drawn analogies between the skin pigmentation and substitude and the vomiting of pregnates, and some of the symptoms of Addison's disease, and have treated some cases of someting of pregnate by the administration, per os or subcutaneously, of 10 drops of the 1 1,000 solution of epinephrin Distinct benefit has been reported from such treatment

Adrenal proparations have been used in cases of gistro intestinal atom, in diabetes insipidus, rickets, ucurristhenia, masthenia, and other conditions where there is no endone of primary adrenal insufficiency.

Pharmacological Uses—The suprurentl glunds (epinephrin, ad rendin) are extensively used us a cardiou visual astimutian as a local hemostatic to delay absorption of local anesthetics and to relive asthmat Solutions of the cetive principle (epinephrin or adminial) have replaced the crude extracts of the glunds for this purpose. The use of the drug in these cases does not differ from that of other pharmacodynamic acents, and its detailed consideration does not properly belong in a chapter on Organother picture. The action of the alkiland equiphrim, has, however, certain peculiarrities which may properly be pointed out in this connection. When applied locally it causes an intense constriction of blood we sels, and this action largely prevents its absorption, hence, when exten by the mouth or subcutaneously it produces a systemic effects only after very large does. One hundred times as much is said to be required to produce

names are proprietary. It seems better to use the word epinephrin, proposed by Abel, to designate the active principle

Untoward Effects of Epmephrm—Considering the extrat to which the drug is used, acadents are very rure. A few deaths have been reported from the injection of the 1 1000 solution into veins or into the uterus. One milligram injected into a vein has caused alarming symptoms, 03 milligram injected into the uteruse cavity has caused collapse for one-half hour.

The intravenous injection of epinephrin is contra indicated in organic heart lesions, nephritis, and arteriosclerosis

A number of cases of necrosis and gangrene of the skin have been re ported following the subcutaneous injection these occurred for the most part in the aged. Necrosis of the jaw has allo been reported

Severe hemorrhage following its local application has been described, this is attributed to the use of too strong solutions which constrict larger weeks, o that the surgeon neglects to tie them

Its repeated administration in large doses to animals is said to cause elevatic changes in the arteries. The fact has been dispitted, if correct, the selections is probably due to the high blood pressure. Very large doses intravenously are fatal the symptoms being a primary eventation and subsequent depression and failure of the central nervous system. Post mortem findings are visceral hemorrhages or pulmonary edema (Vincent)

## SUMMARY

- 1 Complete destruction or loss of the adrenal glands is rapidly fatal, but why this leads to death is still unknown. The adrenal cortex is the part of the organ essential to life.
- 2 The adrenal medula secretes a substance panephrin into the blood In sufficient concentrations this substance has specific and strikin-pharmacological actions on the vascular system the nervous system anger mobilization, the blood and the alimentary canal. But the quantity secreted under normal conditions is not sufficient to produce any of these effects, with the possible exception of a slight action on the heart and some action on the blood capillaries in the nature of controlling their permeability or secretory activity. Whether in conditions of continuity permeability or secretory activity. Whether in conditions of continuity permeability or secretory activity. Whether in conditions of continuity function and intense unscalar and nervous activity there is enough purephrin secreted, by accretory nerve action or through change in the blood flow, to have distinct physiological effects—the emergency function of the medulla—is still an open question. The medullaries exerction also been isolated chamically (epimephrin) and shown to be a neefful drug in many conditions (circulatory depression hemorrhage astlimate) not related to sny hypofunction of the gland. Fpimephrin is probably awate product or an exerction rather than a hormone.

of the nose and utcrus, may be packed with gauze wet with a 1 5,000 or 1 10,000 solution

It has also been administered by the mouth (10 to 20 drops of the 1,000 solution), and also subentianeously in gastric and intestinal hemorphages (as in typhoid fever), sithough some report but little benefit from such use. The value of epinephrin in controlling internal bemorphages is doubtful in all cases except where the drug can be applied directly to the bleedine, surface

Epinephrin has been extensively used to enhance the action of local anotheres, such as cocain, novocain, etc. It exerts this action not only by delaying the absorption of the needbethe (by which the danger of systemic interaction is also lessened), but, in the case of some of the drugs of this class, it seems to have a direct effect upon the action of the anesthetic iteleft (Esch). On the other hand, it is stated (Frohich and Loewi) that cocain increases the sensitiveness of various organs (blood vessels urmany bladder, eye) to epinephrin (and to direct stimulation of the sympathetic nerves), so that a weeker solution of epinephrin suffices to cruse constriction of vessels when combined with cocain. Such combinations of epinephrin and cocuin are useful, not only in cases of operation but in examinations.

A few drops of epinephrin solution, 1 1,000, are frequently added to Schleich's solutions for local ancethesia, it is also used in connection

with the induction of spinal anesthesia.

Epinephrin has been much used to relieve the attacks of bronchal asthma it is applied locally as a spriy (epinephrin 1 part, water 750 parts giveerin 2.0 parts (Zuelzer), aqueous solution, 1 1000 or 1 4,000), or as an outtment (30 to 60 drops of the 1 1,000 solution in deps lare hydrosus and petrolatium, 1 dram each), by subcutaneous in

nection, or by rectal suppository (Matthews)

Preparation and Dosage of Epinephrin—At present the drug is employed almost exclusively in the form of solutions of one of the salts, usually the chlorid of epinephrin. The solutions on the market are usually 1 1000 in normal saline solution, they usually contain a preservative. They deteriorate rither rapidly on exposure to air and hight, becoming first reddish and then brown, slightly reddish solutions may be used but the brown ones should not be used. Many of the commercial solutions as found on the market vary greatly in strength (Schultz) this may be due to deterioration through age, or the solutions may not have been made of proper strength originally. They should be physiologically standardized, unless a very pure preparation of the active principle is used.

The active principle of the medulla is known by a great variety of names adrenalin, adrenin, adrin, suprarenalin supracapsulin, hemisin, suprarenin (both natural and synthetic), epirenin, etc. Most of these dutinct and separate lines of function or only different physiological states of one type of function is still an open question. The chromophile cells contain what appears to be true secretion granules, and the correction mot abundant in the region of the cell adjacent to the lymph spaces and the blood capillaries.

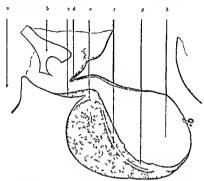


Fig. 12—Mesele, Sachtyel, Section through the Piteltare Body of an author Monkey (semilaranalystic) a, j is i a a b thref ent 1 ( j udiu l um) a d ext in i of p is the un l nound seek, f piteltary e pars anterio ent Lindula is f interplandular eleft g are in seed. h p is nervo a (Herring)

The hypophysis thus resembles the adrenal glunds in origin. The physiological significance of this juxtaposition or fusion of nervous and epithelial structures into one gland runnins unknown. Gaskell has advanced the theory that the hypophysis super, orite the vertical remnunt of the cophagins of our vertebrite uncestors in whom the alimentary tract is supposed to have been placed dorsal to the spinal cord. But the effects following disea or removal of the hypophysis seem to show that it is not vestigal in function whitever be the significance of its peculiar origin and composition.

The histological picture of the hypophysis, especially the anterior lobe

- 3 The only malady in man so far definitely shown to be due to adrenal hypofunction is Addison's disease. Many other conditions, such as acute infections, various eacherius, prolonged mesthesia, shock, etc, my lead to a decrease in the cpinephrin content of the meduilla, but there is no cudence that this is an important fractor in these complications. Timors of the adrenal cortex (hyperfunction?) may be associated with sexual precedity, and there are other indications of interrelation of some of the specific adrenal and specific goard functions, but this interrelation is not of a compensatory nature, for none of the functions of the goands can be assumed by the adrenals, or vice versa.
- 4 Adrenal therapy fresh gland or extracts by mouth or injections have so far failed to maintain the life of adrenal colomized animals. Indit has proved itself of uncertain or no value in Addisons discoss. In view of these facts no credence can be given to the reports of good results from adrenal therapy in disorders (neurosthemia, disorders of pregnancy, etc.) where adrenal hypofunction has not even been established. Adrenal organotherapy is therefore still in the experimental stage.
- organization to the fact that the adrenal medial and its secretion (epinephrin) is the part least essential to his, experimental and empirical organishmaps of Addison's disease should be made with the cortical portion prepared for safe hypodermic injection. It can be considered settled that adrenal feeding is a failure

## THE HYPOPHYSIS

Structure of the Hypophysis—The hypophysis is a very complex an as to structure and possibly in function. The anterior lobe (the glandula pituitaria proper) develops from a discrictulum of the pharugeal epithelium and is, therefore, of ectodermal origin. The posterior lobe (pars nerious or true hypophysis) is a discriticulum from the neural tube (floor of the third sentricle). In the adult this lobe appears to consist of neurogliar cells together with a few nerio cells, and, in some species, of cells and colloid derived from the pars intermedia. The pars intermedia is made up of medified lobe cells in intermediate contact with the posterior lobe. In some animals these pars intermedia cells penetrate for some dissance into the posterior lobe.

The anterior lobe, true to its epithelial origin, appears to have a glandular structure. But the cells making up the organ are not of uniform structure and staming reactions. The cells are usually classified on the hasis of their reactions to stams, such as (1) chromophile, and (2) chromophile. The first group is again subdivided into aeidophile and basophile cells.

Whether these three groups of cells in the anterior lobe represent three

the third ventriele. The theory is accepted by Cu hing and Goetseh and by Cow, and they report the pre ence in the cerebrospinal fluid of a pressor substance detacted in character with printrin. But the results of Cushing have not been confirmed (Carbon and Martin). Then is no demonstrable trace of pituitrin in the cerebrospinal fluid of the normal doc. Whiten supports the theory of a direct isooption of the pituitrix eccetion by the lymph vessels and blood vessels. Herring humself has shown attain some unusuals there is no passige of cell and into the hypophysical stalk. And as for the view that the colloid constitutes the important

secretion tests on the colloud found in the hypophysical elett show it to be physiologically mert at least on the circulation

Accessory Rypophysis —
small nodes of glvadular tis ue
spparcially identical with the
anterior loke are press's in
sman animals including man
es the so-called pinrangeal
hypophysis actually represent
by pophysis actually represent
part of the original concertion of
the introcramial hypophysis with
the pharyingeal ectoderm we
would expect it to edithin
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to 17 Twente months on Hyperbrance tomics: Dix (lest) and Control of Name Pitter right) To of ration was perfore that the else (Amedia)

lob. Lufortunately but hitle attention has tar be n given to this by clinical and experiment it norkers. A dules of glundular tissue inside the cranial carrier in the neighborhol. I fit help plays proper have been described by Dundy and Goetsch under the name purahapophysis.

The most important steps in the development c2 the knowledge of the functions of the hypophisis were the following. The observation (becaming with Rogowisch 1889) that extraption of the throad the guarde of the pancreas leads to a hypertrophy of the hypophisis the report of Marie (1886) of an association between acroning aim and anatomical changes in the hypophisis the discovery (beginning with Oliver and Schofer 1835) that extracts of the jund have mirked effects upon the blood pressure, the heart and the sm with misculature of the body my general especially the uterus the report of Frolich (1901) of an apprentialtion between the hypophisis and the condition known as distriphic adiposagementals the report (by execut investigators but especially be Pauliceo 1907, Cushing 1909 and A chaire 1912) that the total or nearly total extirption of the gland is followed by devito or by characteristics.

is by no means constant throughout life. There appears to be an increase in the chromophile cells at puberty and during pregnancy, and a gradual duminution of them after the fortieth year of life, indicating an adjustment of the organ to metabolic rate and possibly to see life.

Gemelli, Cushin, and Goetsch report that, in hibernating animals during hibernation, the hypophysis decreases in size, and the cells of the anterior lobe lose their characteristic staining reactions to send and basic dyes At the end of hibernation the gland again enlarges, cell division is in evidence and the cells regain their normal staining reactions. On the basis of these findings they accept the theory of Silmon that the depression of the activity of the hypophysis is the primary factor in caus ing hibernation, especially since partial hypophysectomy is said to in duce depression obesity, and somnolence in non hibernatin, animals It must be noted, however, that the completely or nearly complete hypoph sectomized dogs of Aschner, some of which lived over a very, did not hibernate Their appearance did not even suggest the condition of semi hibernating animals. The more recent experiments of Mann and Rasmus sen failed to confirm the hibernation changes in the hypophysis described by Gemelli and by Cushing and Goetsch "There is no hasis for the theory averiling the phenomena of hibernation to lack of function of any or of all the endocrine glands "

According to Fenger, the formation of solid colloid in the pituitary gland does not occur during the growth period, but is a phenomena of adult life. The solid colloidal material in the elefts of the pars intermedia

is insoluble in Ringer's solution and is physiologically inert.

The hypophysis has a very rich blood supply. According to Dandy and Goetsch, the anterior lobe receives the blood supply from eighteen or twenty small arteries from the various components of the circle of Willis. These vessels immediately hretk up into numerous large sinusoidal channels, in apposition with the gland cells and lined only by endothelium. "Hence there are no veins or orteries proper in the anterior lobe substance." The pars intermedia derives its blood supply from the vessels of the stalls, from the posterior lobe, and from the adjacent brain. The posterior lobe is supplied by an artery derived from the internal carotid

A clear knowledge of the hypophyseal circulation is necessary for the interpretation of the results of surgical interference (experimental and clinical) with this organ. From the sympathetic carotid pleus nerve fibers pass to the hypophysis, particularly the anterior lobe (Dandy). It is not known whether these nerves have visomotor, secretory, or sensory function.

On the assumption that the colloid of the posterior lobe constitutes the internal secretion of this part of the gland and the relation of these colloid masses to the cells and fibrous tissue, Herring has advanced the view that this secretion is normally discharged into the cerebrospinal fluid of

epurephrun depends upon the sympathetic unservation and so, under some creumstances causes a relaxation. Epurephrun timulates the endings of the sympathetic nerves of the heart causing an acceleration and any mentation of the heart beat, puturiary extract causes a slowing and at first a stringthening of the beat but this soon gives place to a welkening. The latter effect is probably due in part to the constriction of the concarner, this is antagonized in the interd named by the rie of blood pressure, so that the econdary scalening of the beat is not usually observed.

Howell made the interesting observation that a second injection within one-half to one hour does not can e a second rise of blood prissure it may eren cause a fall. Later a rise  $a_p$ -ani observed. This observation is of importance in connection with the therapeute n e of the extrict. It is not a true immunity according to Dale but small does can be in jected repeatedly at intervils of ten to fifteen minute without significant failure of their pressor effect (Ho kins and McPeck). The active principles excreted in the time.

The rise of blood pressure following injection of posturior lobe extract takes place after removal of the adrenal and is therefore not a secondary

effect due to increased secretion of epinephrin

Arogh has reported experiments intended to show that the hormones of the posterior lobe (putnitrin) control the tonus of the blood capillaries

Von Frankl Hochwart and Frobleh found an increased irratability of the automatic motor nerices of the bladder on faradic stimulation. Similarly the irratability of the hypogastre nerices to the uterus was much increased. These effects were produced only by the first injection of the ottrace.

Megaus and Schafer and also Schafer and Herring reported that the intrateous subcutaneous or intraperitoneal injection of cytruits of the Posterior lobe caused marked and long continued diurcus and dilatation of the kidness. According to the same authorities administration by the mouth also increased the amount of urine secreted both in animals and in man.

There has been considerable discussion as to whether this dimersis is due to a direct action upon the cells of the kidney or is brought about infuredly through changes in the circultion. Selecter and Herring and also Ho kins and Viens support the view that the action is primarily on the kidney cold directly and only conduring added by the chinges in the circulation while Houghton and Merrill and also Kim, and Stolind conclude that it is purely a vascular phenomena the printirin dures is run mag parallel with the visabilitation in the kidneys.

The statement of Schafer that the administration of posterior lobo extract by mouth induces diffusis has not been substitutiated by recent

acteristic effects upon growth and development, the relation of the hypophysis to renal activity (beginning with Schrifer, 1906) and to divides inspirates, the studies on the influence of feeding hypophysis or general growth, and on development of the gounds (Schafer, 1909, Goetsch, 1916, Robertson, 1916). It should be noted, however, that the reliability of much of the above work (experimental and clinical) has been seriously challenged, especially be Caimis and Romsy. Their work indicates that the hypophysis is not an important endocrine organ, the symptoms usually assembed to hypophysis being due to injury to the tuber cinercum and the bro of the midbran.

Function of the Posterior Lohe and the Pars Intermedia —These two parts of the gland must at present be considered together, because, though duffering, in structure and origin, they are automically so closely interworen that they caunot be separated for experimental purposes

Action of the Extract—Oliver and Schafer found that extracts of the entire gland raised the blood pressure. Howell subsequently showed that the o effects were due entirely to the posterior lobe. Schafer and Herring Herring, Cushing and Gottsch, I cwis, Miller and Mathews, have found that the active principle scenis to be formed in the pars intermedia, from which it passes into the posterior lobe. It is also possible that the presence of the pres or substance in the posterior lobe is due to the pus intermedia cells distributed among the neuroglar cells and fibers. In adult humanis there appears to be no true pars intermedia, yet the posterior lobe contains the pressor substance.

The most marked physiological action of extracts of the posterior lobe is to cause a construction of smooth min ele. The construction of the arteries following the administration of such extracts leads to a marked, and, as compared with the effect of epicephirm long continued, rise of blood pressure. The extracts also cause dilatation of the frog s pupils, strong contractions of the iterus and of the alumentary tract.

There is thus some resemblance between the effects of extracts of the pituitary and of the adrenal medully, this is, however, only superficial The effect of epucphrin upon organs containing smooth muscle is generally the same as that of the stimulation of the sympathetic nerves supplying these organs, when the sympathetic nerses inhibition instead of contraction, epinephrin does the same. The effects of pituitary extracts are entirely independent of the sympathetic nerves, they are exerted directly upon the muscle cells (Dule). The action of pituitary extract is mornizely like that of the digitals series, but the effect on smooth muscle is much greater than on the heart muscle. Hence, the effects of the two drugs are in many instances different. Thus, the pituitary causes marked constriction of the coronary and pulmonary vessels, epinephrin has but little effect upon these. Putuitary extract always causes marked contriction of the uterus, whether this is pregnant or at rest, the effect of

stance of the action of posterior lobe sub-tance on smooth muscle and is of no practical importance in pediatrics and sinecology

Weed and Cushing recently reported that extracts of the posterior lobe of the hypophysis increase the rate of production of cerebrospinal fluid (choroidorzher) by stimulating the secretory activity of the choroid plexus But Becht has shown that the apparent increase in the cerebrospinal fluid after such injections is due to circulatory und re puratory changes following the pituitrin injection, and not to an increased secretory activity. Cow reports that extracts of duodenal mucous membrane stimulate the posterior lobe to increased secretion. His experiments are not convincing

Posterior lobe extract, intravenously injected, has a direct action on the respiratory center causing usually an increase in depth of the respiratory movements followed by shallow and slow respiration (Nice Rock, and Courtright). It decreases the rate of secretion of the saliva (Stoland and Lommen).

and Tommen)

Continued daily injections of posterior lob. extract are very deleterious, leading to emiciation, depression fever tissue changes—expendly in the liver—vascular disturbances etc. Harves reports selective changes in the coronary vissels after repeated injection of pituitary extract. This is of greet practical importance. It is a culout that the serious posterior lobe extracts so far prepared do not represent the normal secretion or substance passed into the blood by the gland or else these substances are contaminated by injurious spill products of the cell constituents

The specific pressor substance in the posterior lobe and pars intermedia is in evidence in early fetal life in cattle it can be demonstrated at the e_hth week of gestation (McCord). In the pig fetus only 175 millimeters in length, the pressor substance is very abundant (Levis). If this advance represents an actual internal secretion, the gland is evi-

dently functioning during intra uterine development

The active principle or principles of the posterior lobe have not been solated, and little is known as to their chemistry. They are dialyzable, are not destroyed by boiling and are soluble in water and ethal alcohol (Finger) they resist peptic but not tryptic digestion. They do not use the color reactions characteristic of epincephrin although they seem to give certain decomposition products analogous to those of this compound. The colloid mass as present in the adult a posterior lobe and in the pars intermedia are physiologically inert (Leuis Viller Mathews I cth., Penger). There is no ordin either in the anterior or the posterior lobe even after complete throudectomy (Wells, Sunpson and Hunter), but some posterior lobe, extracts on the market are reported to content Relatively large amounts of calemin and phosphorus are present leades traces of ar cine and hommin (Bacill) cholun gurunn histidin, and histamin have been reported (England and Kut cher, Aldrich Abel and Magayama Jackson and Mills). Koessler and Hisik maintain that

workers In fact Orlandi, Konseheggs, Hoppe Seyler, Frv, Mozfeldt, Rees and others report that feeding, but especially hypodermic injection, of posterior lobe extruct decreases the urine volume both in normal per sons and in various conditions of polyuria, such as disbetes insipidus, without influencing the total solids exercted. Injection (hypodermatic) of posterior lobe extract appears now to be an established therapy for temporary control of diabetes insipidus. This may be a drug action rather than an endocrine action. But so fir as the posterior lobe of the hypoph 3sis is related to diabetes insipidus, it is luck of the secretion rather than the excess of it that leads to the polyuria. When the extract is given by mouth or hypodermatically, the absorption is too slow to induce viscular changes and, hence, the temporary dimensis seen on intravenous in jection does not appear. How pituitrin check dimensis and reduces the urine volume in normal persons and in polyuria is still an open question. Rees has reported work indicating that pituitrin slows the absorption of water from the intestine.

Borchardt, Goetsch, Cushing and Jacobson found that injection of the action of epinephrin. It is not yet known whether the temporary giveosuma obtained by some observers is secondary to the disturbances in circulation, or is in index of a primary and special relation of the posterior lobe to carbohydrate metabolism. Falta, Franchim, Gundri, Mass and others maintain that the administration of posterior lobe extract does not induce hipperglycemia or glycosuma intrinenous injection of extracts of fresh pituitive gland, the anterior or the posterior lobes, or the implantation of the entire fresh gland into the animal does not produce glycosuma in the dog. This is at least true of the quantity of the hypoph yair represented by from two to ten glands of the dog. (Carlson and Martin)

Alleged Galactagogue Action of Posterior Lobe Extract —In 1910, it was reported by Ott and Scott, and subsequently confirmed by Schiffer and Mackenzie, Viawell and Rotheri, and a number of other obseriers, that injection of posterior lobe extract into licitating animals and lactating women causes a temporary flow of milk from the nipple. This was first thought to ho a true "lactagogue" action, and, hence, of great practical importance in medicine. But Ott and Scott reported a similar "lactagogue" action from the injection of thymis, pineal gland, and corpus luterim extract and it was soon discovered that on continual administration of posterior lobe extract there is no increase in the total milk vield either in experimental animals or in women. And it has now been demonstrated (by Games and others) that the apparent lactagogue action of hypophysis extract is due to the contraction of the smooth nuisele in the duct system forcing out any milk already formed in the gland, and not a s'isuulating, action on the milk producing, cells. It is another in

young rats weighing 25 to 50 grams is equivalent to a daily dose of 150 to 500 grams dried gland in a person weighing 60 kilygrams—a quantitater in excess of the total dails protein requirements of the individual It would thus seem that the e experiments are far outside the range of organotherapeutic possibilities for man. Feeding experiments must be made with smaller doses

Function of the Anterior Lobe — Most of our knowledge of the physiological importance of the unterior lote has been secured by the method of extripation, feeding the gland transplantation, direct stimulation and

from diseases (tumors and cysts) of the organ.

Alleged Growth controlling Principle of Anterior Lobe-Tethelin-Apart from the fact that extracts of the anterior lobe like tissue extracts m general, cause on intravenous injection a temporary lowering of the blood pressure (Humburger) nothing of importance has been gained by this line of study of the anterior lobe Robertson isolated a mixture of substances, from the anterior lobe, which according to him has the same stimulating action on growth as the entire gland and hence named by him tethelin. But the influence of anterior lobe feeding on growth is still an open question Tethelm contains 1 4 per cent phosphorus and nitrogen in proportion to four atoms for every atom of phosphorus some of the nitrogen being present in amino groups. It probably contains an imid szolyi group, and to this extent may be regarded as related to the physiologically active substance of the posterior low Lut tethelin does not possess the characteristic physiological activity of the posterior lobe extract, for large doses given intravenously have only a slight depressor action on the blood pressure and practically no action on the heart the uterns or the musculature of the alimentary tract Tethelin has as yet no proved therapeutic value

Extirpation of Anterior Lobe —The literature on the effects of partial and complete removal of the hypophesis since the first paper by Horsley (1886) to the extensive work of Aschner (1913) is a extensive or it is contradictory. Part of the conflicting results are due to the difficulties of the operation (extensive hemorrhage injury to the brain etc.) There is no doubt that removal of the gland by the bosed route is in the limits of skilled experimenters, attended with less hearn injury than the crimal route of Paulesco and Ch hing. The most instructure results are the expected by Cashing and his coworkers, Sweet and Allein Aschner Smith Camus and Poussy. Their studies viewed in the light of the entire literature, appear to warrant the following conclusions.

1 Cutting the stalk of the infinialbulum, or removal of as much of the posterior lobe and pars intermedia as is possible without too great injury to the auterior lobe has no mirked effect on the numel except possibly some tendency to admossive due to murry to the base of the hrain. there is no histamin in the fresh posterior lobe. Crystalline substances showing some of the characteristic activities of posterior lobe extract have been isolated by Aldrich, Houssay, and especially by Fulmer, the litter investigator was able to isolate four crystalline substances exhibiting physical activity. These were named collectively, by Fuhner, 'hypophisin''

The commercial preparation "pituitrin," is an extract of the posterior lobe. One cubic continueter is said to correspond to 0.1 gram of the fresh or to 0.1 gram of the dried gland. "Pituitary liquid" is said to be a 20 per cent extract of the fresh gland.

Standardization of Posterior Lobe Extracts -Roth (1914) found that the various commercial preparations of the posterior lobe on the market varied greatly in physiological activity, some heing fifteen times stronger than others This is a very serious situation, in view of the in erensed use of this extract, especially in obstetrical practice, and because of the serious consequences (such as rupture of the uterus, etc.) that may follow the administration of too large a dose. In view of the fact that there is no sersonal variation in the activity of the posterior lobe, and little or no difference in the activity of the gland from different species of animals (cattle, hogs), the actual variations in the strength of prepara tions must be due to faulty processes of manufacture. It evidently does not suffice to state the strength of the preparation in terms of the percent age of fresh or dried gland present. Roth has demonstrated a practical method of standardization by comparing the extract (using a guinea pig's uterus as a test object) with a definite dilution of histamin. But Abel and Rauiller have recently reported the isolation of a substance from the posterior lobe having forty times the action of equal quantities of bistamin

Posterior lohe extract has become a useful drug in labor. It is obtained that such standardization of posterior lobe extracts for clinical uses would make the substance safer.

Feeding Experiments with Posterior Lobe—The e have so far thrown little or no light on the physiology or possible therapeutio use of the organ Caselli, Sundri and Goetsch report retridation of growth in voung animals on continued feeding. Aldrels, Lewis and Miller noted no effect on growth or health condition of the animals fed Behrenorth obtained indications of mercased rate of maturition of the gonads Goetsch states that feeding the dried powdered posterior lobe extract to young rate in daily doses of 0.1 grain cueses fuline to guin in weight, increased peristalsis, mild enteritis, and certain nervous manifestations such as miscular tremors and weakness of the hind hims these effects are not produced by smaller doses (0.0. grain per day). These smaller doses have no effect on growth but seem to retard the development of the sex glands. A dose of 0.05 grain dried pinturary per day given to

Cushing interprets the results as due to an excessive liberation of posturior lobe secretion into the blood by the trimulation of the gland. Using more accurate methods. Nection and Becht-showed that while direct stimulation of the gland induces hyperglycemia and glycosum; this does not occur in animals with section of the spand cord or the plunchine nerves—a fact which argues against the libration of an hypophiasis hormonic which increases directly the glycogenolysis in the liver. The question of the possibility of inducing excessive hypophiasis activity by direct mechanical stimulation of the gland is of great practical importance in cases of head and brain injuries and bruin unions in in.

Alleged Secretory Nerves to the Hypophysis — I has que tion is as vet an open one, owing in part to the fact that we have no certain test of hopphyseal hyperactivity in crucial experimental stimulations lasting at the most a few hours. Weed Cu hing and Lucob-on and Shannoff reported that stimulation of the cervical mapathetic nerve indespecially the superior cervical ganglion in rabbits undices glycouriv. This they interpret as due to the stimulation of secretory here is by a passing from the cervical sumptifier to the posterior lob. Minoigh using more accurate methods. I alsens and Lufschitz failed to confirm Cusling, so

Effects of Feeding and of Injection of Anterior Lobe Extract Experimental—Challing Sandri Aldrich Grail Wulzen and Vixwell and Leuis and Miller and others report impairment of growth or loss of weight on feeding or injection of anterior lobe substance. This may be due to exce sive doses used Schafer on the other hand reports little or no effect on growth from interior lobe idministration. Robertson, working on time and fredmi, fresh anterior lobe (212 gruin per dix) reports that when the feeding is begin at the fourth week of life there is first a retardation and later on an acceleration of growth to that the hyphophysis fed mace finally attain and may ocen surprise the size of the central animals. However, the pituntary fed animals are on the whole smaller than the controls eithough this weigh more and appear to be more compactly built. There is certainly nothing in the data pre inted by Robertson that indicates an approach to acromegative in the pituntary fed mine. Robertson also found that feeding the substance tethelin (related from the anterior lobe) produced is initially the same effect as feed ing the entire lobe itsage.

In another report Robertson and Burnett state that unjection of an emulsion of the anterior lobe into timors (evrumomats) in mine unercases the rate of the timor growth without unersain, the timbents to mit takes Wulken reports further that the growth of plumman women is accelerated by a due to funetror lobe and pars intermedia; provided the feeding is begun early in life. Any part of the hypophysis increases the rate of fession in these lowly forms. Robertson allo takes that hypodermatic

2 Complete or nearly complete removal of the anterior lobe in voung animals leads to retardation of growth, especially of the skeleton, prevents maturation of the genads, thus causing failure of development of the secondary six characters, causes depression, sluggalines and sonnolence, a tendency to excessive obesity, a lowered rate of metabolism and possibly somo increa e in the carbohydrate tolerance hyperplasia of the thyroid, hymnis, and the cortex of the adrends, it shortens the span of life.

3 The enterior lobe appears to be necessary for normal growth and development, but its removal is not fatal. The death of hypophysectomized animals, as reported hy many workers, within two to itsel days of the operation, with symptoms of extreme depression, is probably due to hemorrhage and hrain injuries. At any rate it does not appear to be due to the loss of the enterior lobe. Complete removal of the posterior lobe and pars intermedia is more difficult without injury to the base of the hrain.

4 In the adult animal complete or partial removal of the anterior lobe max induce a temporary hyperglycenia and glycosuma, excessive deposition of fat, progressive atrophy of the gonada and the sex characters, and various histological change a in the other endocrine glands

5 In most cases partial removal of the hypophysis, or mere operation in the region of the hypophysis, induces a temporary dishetes insipidus

6 It is, at present, impossible to state what part of the symptoms following hypophysectomy is due to brain injuries, what part is due to loss or injury of the glund. I have had apparently completely hypophysectomized dogs showing no demonstrable symptoms.

Transplantation of the Hypophysis—In the hands of most observer the transplanted hypophysis appears to be quickly absorbed without producing any definite effects on the animal. Exper reports a tempority increase in growth when several glands were transplanted into young risk Cushing and his pupils state that symptoms of complete or partial hypophysectomy are delived or diminished, at least for a time by trins planting a part of the gland. The same author reports favorable results, at least temporarily, from transplantation of a child a hypophysis into the brain of a patient suffering, from hypopulutarism due to a hypophysical each. There is nothing in the literature to indicate that a transplanted hypophysis becomes permanently functional in the host. Nor has it as yet been possible to produce any of the armptoms of acromegaly by implanting excessive mounts of hypophysis into animals.

Direct Stimulation of the Hypophysis—Weed Cushing and Jacobson report that direct stimulation of the hypophysis, mechanical or electrical, induces a temporary glycosuria. This is said to occur even after section of the splanching nerves or the spinal cord below the level of the phrenic mucles, showing that it is not due to brain and splanching stimulation

Coshing interprets the results as due to an excessive liberation of potentor lobe secretion into the blood by the stimulation of the slind. Using more accurate methods. Kecton and Becht showed that while direct stimulation of the gland induces hyperglycemia and glycosuria this dos not occur manimals with section of the spinal cord or the plunding nerves—a fact which argues against the liberation of an happings hormone which increases directly the glycogenolysis in the later. The question of the possibility of inducing excessive happings activity by direct mechanical stimulation of the gland is of great practical importance in case of head and brain injuries and brain injuries.

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Effects of Feeding and of Injection of Anterior Lobe Extract Ex perimental -- Cushing, Sandri Aldrich Grail Wulzen and Maxwell and Lewis and Miller, and others report impairment of growth or lbs of weight on feeding or injection of anterior lobe substance. This may be due to exec we doses used Schafer on the other hand reports little or no effect on growth from unterior lobe admini tration working on mice and feeding fresh interior labe (0.12) gram per day) reports that when the feeding is begun at the fourth week of life there is first a retardation and later on an acceleration of growth so that the hyphophysis fed mice finally attain, and may even surpa's the size of the control animals. However the pituitary fed animals are on the whole smaller than the controls, although they weigh more and appear to be more compactly built. There is certuily nothing in the data presented by Robertson that indicates an approach to acromegilia in the pituitary fed mice hobertson also found that feeding the substance tethelin (150lated from the anterior lobe) produced essentially the sime effect as feed ing the entire lobe tissue

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injections of tethichin stimulate the action of tis ue repair as expressed in the replacement of tis we look during a preceding period of starvation or in the healing of granulating wounds.

The extensive studies of Goetsch on white rits seemed to demonstrate the continued feeding of anterior lobe to young animals accelerates body growth and lastens exual maturity, while similar feeding of posterior lobe retards both growth and sexual development. When the anterior lobe is fed to adult rats, sexual activity, as indicated by the number of pregamences, is augmented. Goetsch's work appears commend but it seems difficult to reconcile his 100 per cent positive results with the negative fundings of practically all other uncetigators (cf. kriss). Robert son and Wulzen hive the unpression that the anterior lobe feeding did exert some stimulating action on the sex function in some animals (mee, chickens).

According to Pearl and Surface injection of anterior lobe substance or extrict into the peritonical causts of fowls does not activate the completely resting overy. Feeding the same to eeg laying heat does not accelerate egg production. Feeding the same to eeg laying heat does not accelerate egg production. Feeding the anterior lobe substance to voing pullets does not bring about an earlier activation of the overy. Teeding anterior lobe substance or desic-ated corpus latenin to voing pullets retaids growth but has no effect on the rate of development of sexual maturity. Clirk, on the other hand, reports that feeding the unterior lobe substance to heats increases egg production as well as the fremulation of the egg. This effect becomes eardent after three or four divideding and persists a few days after cossing the feeding. Clirks experiments are entiretzed by Padot. Uhlenhuth reports some excess growth of submander lays effect on the auterior lobe.

The present state of the literature on pituitary feeding of normal experimental animals seems to admit of the following conclusions

- 1 Teeding anterior lobe may slightly accelerate the growth of young animals but there is no endeave that the final stature is greater than that of the control animals. Hence, there is no endeave of experimental acromegalia or greating, at least in manimals.
- 2 Anterior lobe feeding is reported to recelerate sexual maturation in the soing and strainlite sexual activity in the adult animal, while the posterior lobe has the opposite action. But more work is needed before this thesis is established. In view of the conflicting literature, we cannot refrain from expressing the fair that some inflores may have reported what they thought they ongo to have found, rather than impurited objective results. Hypogenitalism and retarded growth are ascribed by ominy clinicians to impuriment or destruction of the hypophysis, hence, that hypophysical organical results appears so revoluble as to bull secentific critique.

Functional Disorders of the Hypophysis Alleged Hyperpituitarism -For some time after the report of a relation between acromegalia and the hypophysis there was much discussion as to whether the discuse was due to a condition of hyperactivity of hypo-activity or of a perverted activity of the gland. The theory has also been advanced that the pitu itary changes in acrome, also are secondary to the bone growths and the general disorders of the body. It is now generally held, though not proved that the former is due to hyperplasia and inerca ed activity of the interior lobe-at least in the early stages of the disease. The primary pathological condition in aeromegalia is usually one of simple hyperplasia (adenoma) of the anterior lobe-e-pecially an increa e in the number of chromophile cells (Lewis, Csepus, Linhlmeter and others) It frequently shows and cations of malignancy It the same time there seems to be at least a functional involvement of the posterior lobe. In late stages there may be an extensive degeneration of the gland, and this has an important bearing upon the possible therapeutic use of the gland in accomegalia The ann literation which may follow the removal of part of the hypophysis in acromegalia (Hochenego) affords additional proof that the condition is one of hyperpituitarism. At the same time it must be admitted that the precise relation of hypophysical activity to acromegalia and gigantism has not yet been established Cognetto advances the following argument against the generally accepted hyperpituitary theory

1 Cases of acromegula have been observed without tumors of the hypothysis.

Adenomas composid entirely of chromophilic cells of the anterior lobe haso been found associated with acromegalia

3 Adenomas of the hypophysis composed entirely of chromophilic cells, but without acrome, that, have also been described '

Two sets of symptoms are cussed by hypertrophy of the hypophysis (1) those which appear to be due to the specific hyperactivity of the gland (2) those produced by the pressure of a tumor in this region. The specific effects suppr et to be due to hyperactivity which may throw some light upon the normal function of the gland are marked and characteristic changes in the features and in the extremities, due partly to the growth of the soft thesics partly to an enlargement of parts of the

bones of the head feet and hands

Auth has tudied in detail the changes in the skull in aeronicalla
and the manner in which they are induced. He concludes that an internal
exerction of the hypophysis structures to use so that they re-point to the
autral stimulo of growth (inclumeal activity and min unlai movement)

In s me cases there are ch noes in the cranial bones without acrome, alia -

with increased energy. The enlargement of the extremities is due largely to connective tissue growth

Among other symptoms of aeromegdia are lassitude, muscle pains, apaths, and disturbiness (depression) in sexual activity, there may be amenorrhed in women and frequently impotence in men, but excessive sexual activity may also be present. Vasomotor changes in the skin activity may also be present. Vasomotor changes in the skin activity may also be present.

borehardt found glecourna in 40 3 per cent of 176 cases. In later stages where the hyperactivity of the gland is being replaced by hyperactivity there is, recording to Gotesch, Cushing und Jacobson, not only no glycosuria, but an increased tolerance for carbohydrates, but these authors consider both the glycosuria (lowered carbohydrate assumitation) and the subsequent intereased actions drate tolerance to be due to hyperactivity and

hypo activity, respectively, of the posterior lobe

The literature on the condition of metabolism in aeromegalis is conflicting, but in the early stages there appears to be a definite retention of calcium, magnesium, and phosphoris (Berglieim, Stewart, and Hawk) probably in consequence of the new bone growth. Part of the contradictory results are probably due to the fact that only the early singles of the disease are associated with hyperactivity of the anterior lobe, and this is followed later by destructive changes in the gland and hypophitarisms (Experimental hypophysectomy) seems to be followed by some lowering of the rate of metabolism, we would expect an increased rate of metabolism in aeromegalia, if it is due primarily to hyperactivity of the hypophysis

The studies of acromegula show that there is a close relationship between the hypophysis and growth, especially of connective tissue, car tilinge and bone, and also between this gland and the activity of the sex glands, thus supporting some of the experimental results on the hypophysis

The relation between the hypophysis and growth has been further ask. I fed by studies on gragantism in this condition also hyperplastic thous mals, bof the hypophysis are frequently found In many of the ehowever the co. other glands of internal secretion are so greatly involved it is impossible or gible to determine whether the changes in the hypophysis rimmary or section belondary. The other glands chiefly involved are the ands, which magued stind be atrophic and the thyroid. In certain cases of me on the other as the diand, the anterior lobe of the hypophysis is said destroyed (Aschmo-phissed).

ism on the other as the object, the anterior lose of the hypophissis is said destroyed (Aschner blished as the connection that favorable results in su interesting to not send the of cibeen reported from the administration of loss gigantism have been considered by the property of the changes and that the changes had been too ted by the injection of testicular extracts may be partly priver from the albino rat there is no hyperplasia of reports, however, that interesting the albino rat there is no hyperplasia of pophysis following spaying

the hyperplasa Tandler suggests that the apecial growth features of eunchism may be due to the hyperplant of the thyr d that tollows castration. But in the rat and the gumea pig the chinges induced in the hypophysis by gonadectoms appear to be of the inture of atrophy or degeneration (Addson Moore).

A condition of hyperpituitan in is believed to exist as has already been in liested, after eastration which usually leads to some enlarge ment of the hypophysis, and also durin, pregnative when some of the functions of the ovaries are in abevance. There are not only charac-



Fro 14 - ADULT Dogs MALE AND FEMALE SOME MONTHS AFTER PENOVAL OF THE GERALEM FAN OF THE PETULTAN I DOW In each cs a control of the same litter is above no the right of the operated annu I. The t and ney to adjustly is marked in both seres (Cushing, a The I stanta y Bify J. B. Lippincott Co.)

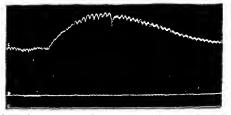
tristic changes in the hypophysis during pregnance as indicated by increase in size and by histological changes but extrain general ampions of pregnance (calargement of the bands changes in the faces suggestive of acromegalia) are considered to be due to the hyperprintifrism. Some of these changes may persist after termination of the pregnance. Hemost of the thrytodal also leads to hypertrophy of the hypophysis.

Remoral of the thyroid also leads to hypertrophy of the hypophysis (Rogowitsch, Levingston) the latter is also found in many ca cs of hyperthyroidism in man Symptoms referable to the hypophysis have been reported after thyroidectomy

Functional Disorders of the Hypophysis Alleged Hypophymiarism — The condition of hypophimiarism is of interest in connection with the organisation repeated by the hypophysis A condition of hypoptimiarism is assumed to exist in the disease 'distribution adipologiumlis,' first described by I roblish in 1901. In this condition there are usually hypophysed tumors or exist of a destructive character, combined with obesit, a hypoplastic condition of the sex glinds and retracted growth or infantism. Some of these symptoms—notably the obesity—occur also in the later stages of accommendation.

The view that this condition is really due to a primary involvement (hypofunctioning) of the hypophysis is larged based upon experiments upon animals (Cushing Aschier) in which the hypophysis is a partially removed as detailed above, and on the effects of elimed organicherapy

(Beck, I ngelbich, Liernes, Limme and others)



I'ld 15 -Tracing Showing the Perfect of Intripryon's Indicator of Public of the Lostenion Lose of the Hypophysis on the Blood pressure (Schalt)

Cushing and his coworkers first leflexed that the above results were some of them the adiposity and meri sed cividal drit to sungsted that some of them (the adiposity and meri sed cividal) drit tokermee) are chieft due to removal or unjury of the posterior lobe. Bell thinks that the hypophysis acts as a single gland. Beek assumes specifie deficience amptoms both of the anterior lobe, namely (1) retarded growth, (2) obssity (3) infinitism (4) hypothermia (5) a chi via, and the posterior lobe (1) is postension, (2) mercased any, tokermen, (4) how best metabolism (4) asthema. Fundibach a sames i type of adiposity specific for posterior lobe deference. Idly and others assume that only posterior lobe deference induces disbettes mappidus.

It must be admitted, however, that it is not possible to state with certainty, in cases of clinical hypomuniarism, which symptoms are due to lack of anterior lobe, and which are due to lack of posterior lobe, or whether any of them are primarily related to hypophysical deficience. When the cysts or neoplasms become sufficiently large, it is probable that

the activity of the entire gland is deprissed (pre-sure atrophy) irrespective of the part of the gland giving rise to the times. The difficulty in the way of hypolysis organio herapy is further increased by the fact that many of the climical symptoms of hypopitularism may arise from distrophy of other glands of internal secretion. Thus impairment of growth and dwarfism and retardation of gonid maturation may be due to this odd deheency, sexual infanthem to primary impairment of the gonid abnormalities in earbohydrate tolerance to discretes of panerias and adverads and lowered metabolism and body temperature to a great number of causes. Outshing, Falta, Beck Engelhel and others this recognize a distinct group of cases with hypophysis involvement but showing at the same time signs of plurighinduly distrophy. The organioherapy of this same time signs of plurighinduly distrophy.

#### SEMMARY

Experimental work and clinical oh errations seem to show that the hypophysis is an organ essential to normal life the removal of which may lead in a short time to death the prival removal or discuss of which may lead to a condition of retarded growth or infantilism to obeath, to simply of the see glands and other disturbances of mitrition hyperativity of the anterior lobe. (in acromegalis and giganism) may lead to accelerated and libnormal bone growth, and ultimately to atrophy of the see glands. Nothing is known as to the nature of the action of this part of the bysonicus.

The posterior lob, and pars intermedia contain a substance or substances havin, marked effects upon plain muscle especially, that of blood tessels and the uttrue and upon the kidner while it thus has important parameted name actions its role in the normal saninal is obscure since it is not certain that this substance is given off by the gland to the body

finida

Therapeutic Uses of the Anterior Lobe—If we assume that the anterior lobe secretes a hormone and if the hormone is absorbed in active form from the alimentary trust thus permittin, administration per os or when it is prepared in sufficient purits to permit of repeated intravenous intrammentar in representation without uniform attraumentar in hopo for favorable results from anterior lobe theraps in all diseases due in whole or in pirt to impaired functions of the hypophysis (hypophysical distrophy, infantisism amenorfice impotence or impaired growth traceable to the hypophysis). The results of climical use of the hypophysical preparations have of an not come up to this expectation. In fact, it has not yet been shown that the effects of partial or complete hypophysicalomy in experimental animals can be essentially and permanently counteracted by hypophysical organilations. The past failure

may be due in part to using the entire gland, rather than the anterior lobe, as there is some evidence that posterior lobe substance counterests the effects of thic anterior lobe substance in some directions. Recent chinical reports record some cases of supposed hypopituitarism in which feeding hypophysis, or hypophysis combined with thyroid, seemed to improve some of the symptoms (adaposit, ginerit aplasia, somnolence, etc.), while other cases showed no improvement. If the diagnosis is correct it is difficult to explain such discordant results. We must be pur treather than the seement in cases of delayed adolescence for here any therappersisted in long enough may seem to be effective, although there may be no causal connection between the theraps and the change, in the pittent. That thiroid feeding reduces adoposity is well established, but what hight

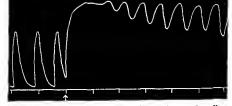


Fig. 16.—Tracing Showing the Action of an Isolated Cornu of Rafa Uteros Suspersion in Loce is Solution of the Addition of Entraut of Posterior Lore of Ox Intitary to the Solution (Hages)

does that throw on hypopituitarism? In the present unsettled state of our knowledge we must be guided by the following principles

- nowledge we must be guided by the following principles

  Diagnosis of hypoprimitarism is in no case certain
- 2 Teeding hypophysis has so far failed to control the symptoms of certain (experimental) hypopituitarism
- 3 Empirical organotherapy in supposed hypopituitarism is justified, but when pluriglandular mixtures are used we are merely treating a disease of unknown origin with a remedy of unknown composition

The hterature shows that, besides the above, hypophysis therapy has been tried with varying results in amenorrhea, menorrhagia, astlina, hemoptysis, insominia, angina pectoris, esteonalaeia, rachitis, rheinmatic and genorrheal arthritis, priositis, tetany, epilepss, dementia pracox,

sterility, impotency, exoplithalmic metter picamonia distilicitis typhoid, has fever

Therapeutic Uses of Extracts of Posterior Lobe (Pituitrin) — ha tracts of the posterior lobe are used chiefly for their offect upon plain muscle, that of the uterus, the got and 11 of vessel and 1 of the central

of the polynria of diabetes marnidus

Many recent writers have reported very fix rible is all from the use of such extracts in interine bein rible. The use of pituitin in aterine atony, and in postpartine him ribles and in other firm is mix will established.

Several writers have advocated the new intentity extract to more to the blood pressure in shock and in vive resident district (procument) diphtheria, typhoid etc.), claiming that is his the rivinity service.

epinephrin of a much more lastin, effect. But such thereps his proved of no practical value. Rices and others have reported good results from pittutary extract in asthins. This is probably an error except in

probably an error except in the so-called "cardiac asthma due to impured exculation. In true bronchard asthma pituitrin not only lias no officet, but may be harmful (Loos ler)

that sex This is Fig. 17 - January Suc. 1 SEP C YEAR CHOWN OF SECRET SEPTIMENT SECTION OF SECTION O

Mention and the Mistar (s. n. Distriction of transfers 12 a stated all second meet better the common section of the common section o

Wiggers considers that it is the only drug, which meets the indications for a hemostatic in pulmonary hem rith, is one it ruses the blood pressure by peripheral action (which is a first; the bleeding points and at the same time presents ancomes of the brant) and cut is a week ring of the boart which presents a right type or in the pulmonary we else

Bell and others recommended it in intestinal paresis after abdominal operations. It is said to act more penetrally on the paretic than on the normal intestine.

hiotz considers it especially valuable in personativa where it not only increases the blood pressure, but timulates peri talses

The drug has been injected antenneon is or sutrumiscularly in do es of 1 to 3 ec of the agnosis entriel 1 ec corre pending to 91 or 92 gram of the fre h gland (posterior lobe) or introvenion 1 in do es of 1 to 2 e district with 20 ee normal selme solution. There is danger of local nerro is when injections of strong, solutions are made subentiament in

It is also valuable in the tympasites of prossions and other infections.-

It has also been given by the mouth in doses corresponding to 0.2 gram to 0.5 gram of the fresh gland, or 1 to 3 grams of the dried gland (posterior lobe)

The drug is contra indicated in all conditions of high blood pressure. Although serious unitoward results from use of primitin do not seem to have been reported, except such accidents as interine rupture from administration of pituitin in labor before dilation of the os, it should be remembered that Harvey has produced sciencia changes in the coronary excesses of aminals, Crowe has seen loss of weight and marked changes in the liver from repeated injections, Theor reports publicated changes in the liver from repeated injections, Theor reports publicated changes in the kidney after prolonged use of large doses, and I ranchim has observed intestinal ulceration and hemorrhage

## GENERAL SUMMARY

While specific hypophysed organotherapy is still in the experimental stage, our present knowledge appears to warrant the following

1 Administration (per os) of anterior lobe in all cases of supposed hypopituitarism

2 Possible value of anterior lobe substance (per os) as a stimulant

to general growth and repair processes

3 The use of posterior lobe extrict (subcutaneously) as a simulant
to smooth muscle (interus, alimentary tract, cardiovascular system) and
as an antidirectio in divoctes insipidus

4 Physicians should insist (1) that posterior lobe extract (pituitrin) is physiologically standardized by Roth's or similar methods, (2) and that uniterior lobe extract be not prepared from the glands of old numals, as there are indications of gradual atrophy of the gland in old age.

## THE OVARIES

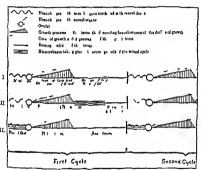
Anatomy —The ovaries of the sexually mature mammahan female contain the following tissues

- 1 Ova in varying stages of maturation
- 2 Follicular epithelium and liquor folliculi
- 3 Corpora lutea, or yellow bodies

In the ovaries of some species (including man), a fourth element, in terstitual cells similar to those of the testes, has been described, hint these do not form such a distinct element of the ovaries and are more readily destroyed by the X-ry than are the cells of Leydig in the testes. The ovarian interstitual cells are said to increase during pregnancy and undergo retrogression during inhernation.

The corpora lutea are not present in the overy before puberty. This particular element can, therefore, assume no role in the development of the anatomical and physiological characters peculiar to the temale sex

Influences of Congenital Absence Airophy and Extripation of Ovaries.—If the overnes are removed in the youn, female the development of all the secondary see characters is arrested. The uterus, fallopian tubes mammary glands and the external genitalia remain infantile licat or rut, and, in the primates mensionation do no occur. It is



F10 18-DIAGRAMMATIC REFRISENTATION OF THE SEXUAL CYCLF I In the guinea p. II In apre and omen III In th d g (L. Loeb)

claimed that there is a tendency to development of some of the male physical and mental cluracteristics. The metabolism is lowered and in some individuals there is a tendency to adjustic, just as in the castrated male. Stotzenburg reports that complete ovariotomy in the viety young rat accelerates the rate of growth, at least during, the first year. Spaving, seem to induce less change, in other endocrine glauds than castration and, strange to say, in some cises the changes are of the opposite character. Outmotomy in the rat levis to distract, in the size of the adrenals while castration causes adrenal hypertrophy. In the domesticated white rat (mornal) the advenals and the hypophysis are larger than in the male rat (Hatai). The agginificance of thus is not appirent. Outmotomy in early

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Halban reports successful ovarian transplantation in experiments upon monkeys

All workers in this field agree on the main points. The ovarian transplant as long as it lives, muntains all the bormone functions of the ovaries in their normal position. These functions are, therefore, internal secretion processes, that is, primarily humoral, not nervous reflexes.

Clinical—Ovarian transplantation bemoiransplantation and hetero transplantation in women has been resorted to extensively in recent vears mainly to control the artificial menopanue symptoms due to ovarotomy or to strophied or discussed ovaries (Morris Glass, Dudles, Kramer Tuffer Martin and others) Clinical results have not been is uniformly successful as those on experimental animals; probably for these reasons (1) In many instances the ovarian graft was not normal to sturt with (infection etc.) (2) In other cases the state of heitht and nutritive condition of the women receiving the graft were below pir—and this militated against a successful take? (3) Many surgeons have made the matthe of transplanting an entire ovary instead of one or more small precise of it. The entire ovary is o large that there will be autolisus and complete destruction of most of the trunsplanted organ before blood vessels have had time to grow in to maintain its life.

As in the experimental work, autografts have proved more useful than heterotransplants. But Martin notes that either type of transplant may undergo eystic degeneration. So long as a sufficient quantity of ovarian tissue remains the transplant is able to sustain normal ser life, including mensituation. But at the best otarian transplantation for clinical purposes is so far only a temporary expedient. The cause of the ultimate atrophy of the ovarian graft, once adequately vascularized is not known

Chemistry of Ovarian Extracts - The ovary produces in all probability, several hormones but none of them has so far been a clated and chemically defined or detected in the blood although Youatt claims that cows can be brought on rut by feeding them milk from cows in rut Lillie has shown that the mature ora of certum unvertebrates secrete a substance which acts on the sperm to render it capable of penetrating and fertilizing the ovurn In the absence of this substance union of ovum and sperin does not take place. This abstance thus appears to act like the opsoning in phrasectoris. The substance is named fertilizin by Dr Lillic It can be extracted from the ripe ova by various means and thus shows some stability. It is likely that similar fertilizins have a role in the proces es of nmon of sperm and ovum in the vertebrate in cluding man but this hormone or secretion is obviously not concerned in the development and maintenance of ex life, as ripe over are not present before adole cence and after adolescence they are present only at definite periods

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Overfotom in the adult and sexually mature female leads to atrophy of the anatomical sex characters of the female, suppression of all sex functions and most ax behaviors and, in women, to some of the mental and physical symptoms of the natural menopause, such as nerrous and circulators disorders. The persistence of menetration in women after supposedly complete surgical ovariotoms is obviously due to ovarian reminants. This is all the more evident since the clinical literature contains instances of pregnance occurring after complete ovariotoms, which, of course, would otherwise be ab-olately impossible. In adult bitches ovariotomy leads to a heightened excitability of the sympthetic nervos system (Hoshius and Wheelon), this may be the condition that causes the interiors and circulatory disturbances of the artificial menopauso in women.

Ovarian Transplantation—Experimental—In all species so far tried the ovaries may be successfully removed from their normal position to other parts of the body and continue to maintain their normal functions for considerable periods Transplantation from one individual to another of the same species appears to yield only a temporary succe. s, although Steinach and Sand report grafting of overies into castrated males, and testes into spived female guiner pigs, the transplants living and func-tioning long enough to develop female behavior in the original males and male behavior in the original females. Marshall and Tolly, working on rats, found that the transplanted oversan tissue exhibited all the his tological features of normal ovarian tissue, except that the germinal epithelium was invariable absorbed after a short time. In some cases other degenerative changes took place The stroma might remain normal, while all the follicles had disappeared, or the greater part of the graft might be composed of luteral tassue alone. A point of great importance, noted by these investigators, is that the overion transplant undergoes the same cyclic changes as the normal ovaries In animals killed shortly before the breeding season, large follicles were found in the grift, while a little later corport lutes were present, showing that ovulation had occurred in the transplant. This has recently been confirmed by Moore on rats and guinea pigs Moore has also succeeded in grafting oraries into normal males having infact tester The ovarion grift in the male becomes vascularized, grows and undergoes the normal cyclic changes. In one case a homoplastic ovarian graft was found healthy after fourteen months. The longest time noted for a heterotransplanted ovary was six months.

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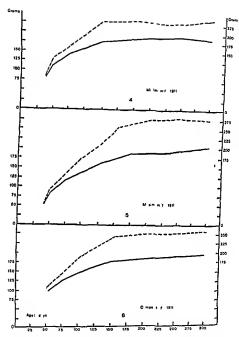


Fig. 19 -- Effect of Spaying on Growth in the White Rat Solid line represents control broken line represents apayed rate of same litter (Hata)

corpus luteum. He claims that injection of this substance into animals causes by peremia of the uterus

Seitz. Wintz and Fingerbut report that they have isolated two physiclogically active substances from the corpus Inteum (1) a luteolipoid and (2) lipoprotein or legithalhumin called hipamin. They state that the injection of the latter into animals stimulates the growth of the genitalia, while its injection into women suffering from amenorrhea in duces menstruation The luteolipoid on the other hand, is said to decrease the men es, and therefore be useful in menorrhagia, especially the excess sive menstruction of puberty. We may remark that these two bodies were not chemically isolated and identified and the clinical findings are not conclusive. For example, the amount of the menses is not accurately determined According to the theory propo ed by Scitz Wintz and Fin gerhut normal menstruction is a function of the proper balance of the luteolipoid' and the 'lipamin' secretions of the corpus luteum seems untenable for the following rea ons (1) These substances were prepared from the corpora lutea of animals that do not menstruate (2) In women menstruction is usually suppressed by pregnancy despite the persistence and great development of the corpus lutsum of pregnancy (3) Menstruction (or rut) may precede ovulation and hence may procede the appearance of corpora lutea Doisy and Allen have recently reparted the isolation of a hormone from the liquor folloculi that appears to control estrus in animals

Specific Role of the Corpus Luteum -The sex life of the mature mammalian female is much more complex than that of the male. With it are associated ovulation gestation and the nursing of the newly born A very complicated situation is the practical absence of menstruction in all mammals below the primates the relative scantiness of men truation in all primates below man and the apparently serious symptoms associated with amenorrhed as well as menorrhagea in women. It is possible that amenorrhea per se may not be serious but that the symptoms are due to the underlying causes that suppress the menses Menorrhagia is, of course serious by itself in that it may produce anemia There is no question but that menstruction in women is primarily a function depend ing on the mature and normal ovary Does the fact that menstruation occurs in women, but not in the lower mammals, indicate a fundamental difference in ovarian physiology in the primites? The answer to this question is of fundamental importance to practical ovarian organotherapy as the only available material for such therapy is the ovaries of the lower mammals So far as we know ovarian materials from the apes have not been tried, clinically

The corpus luteum is a temporar, organ essentially of the mammalian ovary but it is also present in birds. The obvious parallelism of this organ with menstruation and pregnancy has naturally directed experi

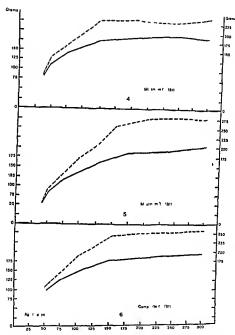


Fig. 19 — Errect of Spating on Growth in the White Rat Solid line represents control broken line represents spayed rats of same litter (Hatai)

injections of fetal and placental extracts into virgins allo cause hyper plasia of the mammary gland

4 Experimental work does not support the view of Frankel that the corpus luteum induces or controls e trum or menstruation as in some animals, at least the processions and estrous uterine hyperchina pricedes orulation and therefore takes place in the ablince of colpora luteu in the ovary

Alleged Antagonism between Testicular and Ovarian Hormones—While the sex lift. especially of the minimalian female is more complex than that of the male, the essential nature of the sex urgs appears to be the same in both sexes. This would seem to indicate similar or identical sex hormones. This sex urge and the development and maintenance of the secondary sex characters depend on the ovaries and testes, and given the different embryological substrate for the characters it would seem that these might be timulated to normal development by identical hormonics. Recent experimental work does not support this view. The essential hormonics of the ovaries and testes appear not only to be different, but mitually antagonistic, at least in certain stages of development and yet they produce, directly or indirectly the same or similar mental states in mala and female.

We have already referred to the work of Stemach Riddle Sand, More and others, of producing 'maleness in the female and female-ness' in the male by changing the sonids or administration of gonad extracts of the opposite sex. But the most significant contribution to this subject has been reported by Lillie Lillies work was done on the freemartin The term freemartin' is applied to the femile of hetero sexual twins of cattle It is well established that such females are usually barren Lillie finds that a twin preguancy in cattle is almost always a result of the fertilization of an ovum from each ovary development begins separately in each horn of the uterus. The rapidly clongating ova meet and fuse in the main body of the uterus at some time between the 10 millimeter and the 20 millimeter state. The blood vessels from each side then anastomose in the connecting part of the chorion a par ticularly wide arterial anastomosis develops so that either fetus can be injected from the other. The arterial circulation of each also overlaps the venous territory of the other, so that a constant interchange of bleed takes place. If both are males or both are females no harm results from this but if one is malo and the other female the reproductive system of the female, especially the ovaries, is largely suppressed, and certain male organs develop in the female. This is according to Lillie unques tionably to be interpreted as a case of hormone action. The sterilization of the femile by the male appears to be due to more precocious development of the fetal male hormones There is no dominance of testes hormental and clinical attention to this organ as a factor of control in these processes The work of Frankel, Marshall, and Loeb appears to have established the following facts

The corpus luteum is nece sary for interine changes involved in the implantation and early stages of growth of the fertilized orum. Ovariotomy or destruction of the corpus luteum by cautery in early preg nancy (first few days or weeks, the time varying in different species) invariably terminates the pregnancy. When the corpus luteum is de-

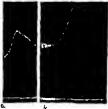


Fig 20 -Pecono or Dor Snowing Pe ACTION TO 05 CUBIC CENTIMETERS NICOTITY (1 2000 DILL TTOY) a BE FORE AND b 46 DATS AFTER PATER PATION OF THE CHARLES Blood pres sure from femoral artery Time 5 seconds (Hoskins)

stroved or the overies removed later the course of the pregnancy or the hypertrophy of the mammary gland is not interfered with. The latter statement is also confirmed by clinical results Ansel and Boum, and especially Lock, have shown that these changes in the uterus induced by ovu lation and the corpus luteum do not appear to depend on the fertilization of the ovum

It must be remembered, however, that there is some hypertrophy of the ovarian stroma parallel with the development of the corpus luteum of pregnancy, and from the further fact that the luteal cells are derived from the stroma, there remains the possi bility that the stromy cells share in the above rule of the vellow body in

early pregnancy

2 The corpus luteum of pregnancy appears to delay the maturation of the ova, thus preventing orniation. This is probably not entirely a local action on the overs, for a well-developed corpus luteum on one overy appears to be able to inhabit evulation in the every of the opposite side Peurl and Surface report that administration of corpus hiteum to hens causes a temporary anhibition of ovulation

3 The corpus luteum appears to play a part in the hyperplasia of the mammary gland that occurs during pregnancy (Ansel and Bouin, O Donoghue, Hummond and Marshall, Ott and Scott) It is stated that of the greation follicle of a virgin rabbit is ruptured by mechanical means, so that a corpus luteum is formed, hyperplasia of the mammary glands is produced, and also that administration of corpus luteum to virgin animals induces hyperplasia But the situation is complicated by the findings of Miss Lane-Claypon and Starling, and of Aschner, that similar

injections of fetal and placental extracts into virgins also cause hyperplasia of the mamming gland

4 Experimental work does not support the New of Frankel that the corpus luteum induces or controls e trum, or menetration is in some animals, at level, the procedures and entrops uterine hyperenus precedes ordation and therefore takes place in the absence of corpora lutea in the overy

Alleged Antagonism between Testicular and Ovarian Hormones—While the sex life, especially of the mammalian female is more complex than that of the male the essential nature of the exturge appears to be the same in both seves. This would seem to indicate similar or identical sex hormones. This sex urge and the development and maintenance of the secondary ext characters depend on the ovaries and testes and given the different embryological substrate for the characters it would cein that these might be stimulated to normal development by identical hormones. Peem experimental work does not support this view. The essential hormones of the ovaries and testes appear not only to be different but mutually antagonistic, at least in certain stages of development and yet they produce, directly or indirectly, the same or similar mental states in male and female.

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If these observations and interpretations of I illic are confirmed and extended to other animals, we have the extraordinary fact of the development of specific gound hormones before the gounds have undergone any appreciable differentiation. If this shall prove to be the case, these hormones can be produced by nothing else than the primitive germ cells

We have evidence that other endocrine glands (pincras, thyroid) assume functional importance sometimes during, intra uterine life, but to observations of Lillie place the beginning of first hormone equilibrium earlier than inturto thought possible. It also raises the question of the evchange of gonad hormones between the first and the maternal blood of the hormone of a made thid obviously does not influence the set life of the mother. I illies interpretation of the genesis of the freemarin is called in question by the condition of true hermaphicolism—courses and testes being present in the same individual, or testes being present with the secondary sex character of the femal, and vice versa. In the lower animals who normally harbor both overs and testes (co-testis) in the same individual or whose genads may produce aperin during one period and one at another period, definite secondary sex characters are usually absent.

Experimental Administration of Ovarian Extract—We have seen that complet extraction of the ovaries leads to atrophy of the uture, mamman, flands and other see characters. These are anatomical or objective changes that may be accurately measured. It would therefore seem that it ought not to be difficult to decode whether ovarian administration is cap blee of preventing or dimmediate, the effects of ovariotisms. Nevertheless the literature is conflicting. Intrince and Bentiuer and also Carmichial and Marshall state that ovarian administration fails to prevent the atrophy of the interns. Okinehits claims, on the other hand, that the intrine atrophy following spring is prevented by injections of extracts of the chorion, but not be extracts of the cliental tissue, and be extracted of the chorion, but not be extracted of the corpus lineum. The corpus lineum of pregnancy inhibits oxidation, but administration of based extracts does not inhibit ovuldation, but administration of based extracts does not inhibit ovuldation.

Various toxic effects have been observed from injections of obstructures (for example disturbence of calcium and phosphorus metabolism) particularly in prignant similars. Solowice reports that corpus intuing and ovarian extracts administered substitutionary to lactating animals cause increased secretion of milk and at the same time general deleterous effects leading to death of the animals. These injections are said to be non-toxic in non-pregnant and non-lactiting animals. This action of overant extract on the maintries pland was also noted by Oct and Secti

Mackenzie reported that it is absent from extracts of ovarie containing no corous luteum. The substance must therefore, be a product of the latter organ. This mammary gland action of corpus lateum a like that of

nituitrin, not a true secretion of milk but the stimulation of the smooth nursele in the walls of the mammary alveoli thus expelling the milk that has already been

formed (Schafer)

Itagaki a pupil of Schafer reports that extracts of the hilum (inter titial cells) of the ovary depress the tone and contractions of the uterns. Extracts of the follocular tissue and the liquor folliculi itself, produce mereved tone and tronger contractions of the uterus Whether these substances are artefacts or normal products assuming a role in Fic life for example in the uterino cramps of painful menstruction as an important

practical question that calls for speedy According to Sick corpus luteal tissue added to the food of rats

tends to produce adaposity. Figher 1 states that the enlar ement of the

hypophy is following spaying is prevented by ovarian feeding



I -COMPOSITE CURVES SHOWING BLOOD FRE URE PERFORMEN TO STARBARD D. ES OF MICOTAL ontinuou line repre enta reactio a tefore th broken | ne after castra tion of dg (Wheelon )

Therapeutic Use of Ovarian Preparations -At present the use of ovarian preparations as or motherapeutic agents is confined to gonecology, and their detailed discussion properly belongs in special works on this subject. But it is possible however that with increasing knowl edge of the relations of these glands to other organs of internal ceretion they acquire importance in connection with general internal medicine

The definite conditions where the ovariou organotherapy might prove u eful are infantilism in cirls and the menopause artificial and physic

logical, as these conditions are clearly due to ovarian hypofunction

Many writers report favorable results in menopause cases attacks of giddiness trembling palpitation, flushings aweatings and other nervous and vasomotor disturbances are reported to be much reduced in number and everity or to have ceased entirely in some cases best results are obtained in cases of postoperative menopruse especially in young women Relap to are said to occur after stopping the treat ment Many cases have been reported in which the results were nega tive, and in some of those with improvement unge tion may have been an important element. The most judicial and convincing clinical contri lution to ovarian therapy in recent years is that of Novak On the basis of his own extensive clinical experience as well as his critical analysis of the Intersture, Novak cancindes that, to date, climical ovarian organotherapy is purely experimental, that taking the natural history of hypoovarian disorders into consideration one cannot say as a proved fact that ovarian administration has had any beneficial effect apart from the element of suggestion.

I veepting the menopiuse, practically all the disorders of sex life of women may be due to causes other than a primary ovarian deficiency, so that the use of overian preparations in all of these conditions is at pre ent largely empirical, both because of the uncertainties of diagnosis and because of the nucertainty as to the kind of ovarian therapy indicated As Marshall has aptly remarked, "it would seem nureasonable to expect to obtain uniform results from the indiscriminate uses of ovaries in differ ent stages of excheal activity, for example, ovaries with prominent follicles like those from animals in heat, or ovaries with corpora lutea like those of premunt animals or ovaries in a state of relative quiescence like those of ancetrous number. And it must not be forgotten that ovaries of many of the lower manuals also differ markedly from those of man, in accordance with the differences in the sex life. For that reason oversan material from the ages should be given a thorough trial. Some of the conditions in which overion medication has been tried, with varying degrees of success are infantilism, amenorrhea, dysmenorrhea, sterility, repeated abortion, hyperemesis gravidarum, toxemia of pregnancy, prari the valve, deficient halk secretion. Watson reports that he has rarely seen any good effects from ovarian extracts in any of the e-conditions

In recent veirs, following the work and theories of Frankel, the corpus lateum, or extracts of this orgui, has largely replaced the extract of the entire ovars in the therapy of funds sex disorders. This is unfortunate as Frankel's theory is, at least in part, untenable as the gained pig 1 co Joel concludes that the presence of a functionating corpus lateum is necessary for certain of the eveloc changes in the interns, for other attrine changes the absence of the vellow both is necessary, while for still other phases of the evello uterine changes the ovariant structures (probably matter, follocles rather than the so-called interstitud cells) are required. But, practicully, it may make little difference, as it is not likely that any drug manufacturer is so eareful that all ovariant stroma and follicular tissue are evaluded from his litted preparations.

Chineal experience, however, has not been uniform Frankel reports more or less favorable results in disturbances pforts a menopouse, etc., but the drug had no effect ou dy-unenorrhen, foully to nener in, and the intovections of preguinces

Recently it has been especially recy The cand scently menstruction, and when dactat may be due to this insufficiency. Hand

strual flow, and to prevent nervous conditions accompanying their functional deficiency

Arusen states that in so called ovarian insufficiency improvement usu ally follows corous luteum administration if persisted in for a long time Burnam reports good results from corpus luteum _iven by month in menopause, functional amenorrhea in young women sterility and repeated abortion Burnam states that corpus luteum does not induce men struction in the complete absence of the overies. This is contradicted by Donnereuther (one case, no control) This author using the corpus luteum of pregnant cons, reports uniformly good results in menopau e, functional amenorrhea and dismenorrhea sterility not due to infection or mechanical defects, hyperemesis in early pregnancy repeated abortion acurasthenic symptoms during menstruction etc. (albertson reports good results from corpus luteum feeding on the vasomotor disturbances of the menopause Other climicians report negative or indifferent results from corpus Inteum therapy in all of these conditions. Dalche states that in dysmenorrhea long continued use of there id gives better results than preparations of the overv In Frankel's hands corpus luteum gave results only in menopause cases Leighton states that a small number of cases of dysmenorrhea, presumably due to ovariou hypotunction, are improved by givin, corpus lutenm 1, to 20 rains per day, for a long time. In some instances this medication caused a tro intestinal disorders, but no other untoward effect. According to Climenko corpus luteum extracts do not act as hormones and cannot take the place of a functional corpus luteum. He thinks these extracts may stimulate an intact but hypofunctioning corpus lateum

In view of the fact that so many physicians have reported good results from corpus lineum therapy in the amenorrhea of adolescence we were struck by the recent paper of Landsberg in which be claims to hive circle seven cases of menorrhagus of adolescence by a corpus lineum pripria tion. It would thus appear that the very opposite conditions amenorrhea and menorrhagus, are both controlled by the same sometic corpus lineum? It is probable that the lineal therapy has no causal relation to the improvement or cure of either condition as there is no evidence that the yellow body influences menstruation except directly through its inhibitory control of ovulation. At any rate we must conclude that so far midical sense, has failed to reproduce (experimentally or clinically) by lineal extracts the effects produced by the mater corpus luteum. The intact corpus luteum inhibits ovulation, linted extracts do not.

Causes for Failure of Ovarian Therapy —These are probably complex We may destroy or lose the ovarian hormones in the preparation of the substance as in the degreesing process of preparing the ovarian extricts or powder. The hormones may be destroyed in the alimentary canal or fail to be absorbed. There are indications, for example, that the gonad

hormones do not pass through the placenta. Finally, it must ever be kept in mind that practically all the disorders of the sex life of women may have their initial cuise outside of ovarian hypofunction. It is well established that amenorrhea may come as a result of quantitative and qualitative undermutrition, and mas, chronic infection, I yodiv roudism, and possibly from hypoptinitarism. This may seem to be an argument for polyglaudular organotherapy in disorders of sex function in women But, because of the failure of ovarian therapy in frank or certain osarian hypofunction, there seems to me no good reason for adding ovarian extract to thyroid extract in our endeavor to restablish menstruation suppressed by mayedema

Methods of Preparation and Administration—The ovars (usually of the cow) has been administered by mouth in the fresh and dried state, and in the form of various extracts, both orally and subentineously. At present it is most frequently fed in the form of the dried fat free powder, in doses of 00b to 05 grim (1 to 8 grains) or more three or more times a day. As it sometimes causes disturbances of direction, its use

may be interrupted at times

The dried gland is frequently administered in the form of tablets, the designation of the weights of the commercial tablets is as lacking in uniformity as in the case of thyroid tablets

The dried powdered corpus luteum (also called 'lutein') has been administered in doses of ½ to 2 gruins (0.03 to 0.12) or more, three times a day. It has been used in the form of various extracts. Value used a sterile 1 per cent extract of the corpus luteum in normal saline solution injected subentaneously in doses of 10 e.c.

No clinical progress can be expected from further use of commercial preparations until methods of chemical and play-sological standardization of ovarian products have been worked out and applied

# SUMMARY

1 The ovaries produce several physiologically important substances or hormones, none of which have been isolated and chemically defined in any ovarine extract so far made for experimental or therapeutic pur poses. The development and maintenance of the secondary sev characters of the female is clearly a function of the ovarian stroma and possibly the immature follicles. The imitation of extrustion or rutting is evidently a function of the mature follicles primarily in corpus luteum is essential for the processes of the early stages of pregnancy. It also retards the maturation of other granfian follicles thus preventing estruin, menstruation, and ovulation during pregnancy. The ovarian hormones thus control, in part, the activity of the ovaries themselves, and the

specific sex functions of distant organs such as the uterus the placenta and the mammary glands

2 The menopause syndrome, natural and artificial is primarily due to absence of or hypofunction of the ovaries. All other disorders of the ex life of women may be due to complications outside the ovaries Some of these complications involve other endocrine glands notably the thyroids possibly the hypophysis and the adrenals. In these conditions diagnosis is frequently uncertain, and, unle s the malady is clearly due to ovarian hypofunction, ovarian organotherapy cannot be expected to yield results

3 In the present state of ovarian physiology organotherapy of the natural and artificial menopanse should be undertaken with the extract of the entire ovary rather than with corpus luteum preparations, as the rule of the latter organ concerns some phases of the early tages of preg-nancy and suppression of ovulation while the other ovarian tissues sustain the fundamental processes of sex life

#### THE FETUS AND THE PLACENTA

Chemical substances or hormones vielded by the growing fetus (and possibly by the placenta) to the maternal blood appear to control the hyperplasia of the mammary gland during pregnancy even to the point of actual initiation of the mile secretion (Lane Claypon and Starling Aschner) This is probably the normal mechanism, although there are cases on record of mammary hyperplasis and milk accretion in adult virgins and even in males But there is no practical therapeutic applica tion of this fact, as there is no reliable evidence that feeding placenta or fetal extracts will improve the quality or quantity of milk in nursing mothers (Hammet and McNeile) or develop the breasts in cases where this may be desired for cosmetic reasons. Aschner reports that placental extract causes ovarian hyperemia, nicrine congestion and hyperplasia hence he suggests the use of placental extracts in amenorrhea and sterility Van Hoosen Cornell and Hammet have reported that daily feedings of dried placenta to mothers during the first few weeks of lactation lead to increased growth of the nursing infant. They conclude from this that the placenta produces a growth stimulating hormone, and suggest that this hormone may be a factor in the growth of the fetus The results reported by Hammet, even if corroborated, may be due to dietary factors also found in other tissues

#### SUMMARY

There is at present no rehable evidence that the placenta secretes a hormone or hormones having useful or important actions on the mother or the fetus actions that can be displicated by feeding placenta there is as yet no placental organotherapy

## THE MAMMARY GLAND

The mammary bland is an organ found only in the highest group of vertebrates, rudimentary in the mule, and in the female active only for a certain period after partirition. It is not likely that an organ so limited in its distribution and activity has itself any important influence on the vital processes of the mammalian female. The important problems in minimitry bland physiology are the dictiry and hormone inclamism of the gestation hyperplisma and the po-tpartini multi-secretion.

There is not much evidence that the manusary gland produces an internal secretion, beyond the fact that, in women, menstraction is insulfation abcounce during the height of Deviation, but in other mammals heat or estruction appears shortly after partirition. There is, however, some evidence that it contains substances which have effects (probable not specific) upon metabolism. Thus Hint reports that, when mammary gland is fed to animals, it can so thought in metabolism analogous in

certain respects to those caused by thyroid feeding

Complete removal of the membrary gland in the adult female is not known to produce any bit payethe and councite effects. The complete removal of the membrary glands in young females is said to retird sexual maturity, and the growth of the uterns (Scherbal). Part such mutilited females become pregnint and give birth to young as under normal could tons. Nursing histens the modificient of the interns (rat, ginner pix). This effect is produced even after spaying (Nuraimitia and Toch). This may be merely an effect of the interessed metabolism in connection with the active lactition.

Injections of mammuns gland extracts are said to retard the development of the overies and the external contribut (Schiffmann and Vystavel) According to Adler they inhabit heat and conception, and in gravid

animals can e abortion

According to Osborne, Innex and others, manners glund extracts decrease uterine bemorrhages. Several authors (Ball Fedoroff, Meksachiants) report the cure of uterine fibroness and myoms by these injections! Sellbeum proposes the remoral of the manners gland to cure celumpat. Hammet gnesses that stumulation of the breasts relevies mammary hormones into the blood, hormones that cause contraction of the uterus! Healy and Kistle suggest that a mammary hormone is responsible for the intuition of blood.

Mackenzie claims that the mainmary gland contains a true galacta gogue or milk producing hormone. This would be of great clinical importance, if true, but Gaim contradicts it squarely, and, in the light of Gaines' work, the results of Mackenzie ire in all probability erroncous

There is no reliable evidence that the mammary gland is an endocrine

orgun, or that feeding mammur gland substance produces any specific or useful effects in health or disease. Hence there is no rational or useful organotherapy of the mammary gland at present

#### THE TESTES

Physiology—The testicles, at hast of the higher vertebrates contain two distinct types of cillular elements having, audically different functions (1) the interestinal cells of Levilo, and (2) the spermitogonia, which develop into spermatozon. The role of the permatozonia and spermatozon is clear, namely the featibleation of the female owning. This fertilization moviles two factors on the part of the mile of most (1) a timulus to development of the owning and (2) a vehicle of paternal heredity. In performing the c functions the spermatozon act, from the point of time of the made as an extremal secretion.

Numerous attempts have been made to solute the substances in the spermatezoa concerned in the c two functions. In the case of some of the lower animals various extracts of the perm are repriet to induce development in the outin, but there is no evidence that the piternal hereditary factors can be conveyed to the ovum by bathing the ovum in sperm extract

The interstitul cells of Levda, vary greath as regards relative abundance in the testes of different space. They are quite abundant in man In embryonic development the interstitual cells antical the permatogonic In animals showing seasonal periodicity in sex activity the interstitual cells appear to be more abundant during excual rest than during the period of rut (Tandler and Gross). The interstitual cells exhibit greater rest state to various agencies. Exposure of the testicle to the X-rays kads to de-generation and atrophy of the spermato, onto before that of the interstitual cells. In testick, transplants, in the condition of cryptorchid ism, and after higation of the vas deferens the cells of Levdig persist apparently in normal condition long after atrophy of the spermatogonic Bat recent work of Moreo or rats and guine pigs seems to show that ligation of the vas does not always induce atrophy of the summiferous tubules.

Influence of Congenital Absence Atrophy or Extripation of Testicles.—The effects of cutration have been known for a long time through its extensive prictice in unimal bushandry and on love and men for religious and social purpo es in vivion countries. Removal of the testicles in the young perfebrate and he has the followine, effects

1 It prevents the development of all the secondary male characters (pens prostate gland beard male larynx, male skeletal characters kin

## THE MAMMARY GLAND

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menopause in women. There is no rehable evidence that castration shortens the span of his or mensuribly impairs the individual sphiscial and mental efficiency. Senescence in the null is that far, not a direct consequence of hypofunction of the testicles but the result of age, impairment of all the tissues.

On the basis of extensive studies on the effects of consideromy in the rat. Hatar concludes that 'the partial removal of the say aliands does not produce an significant alterations in any of the diffusion and said from a general tendency to a slight increase. Apparently the increase in the remaining gland is sufficient to compensate for the functions of the lost sland'.

The total removal of sev glunds, however induces alterations in all the other glands particularly in the thrums and hipophy is a like aupra real glands show opposite reactions in the two sever. In the case of the males, the supraronal glands show an interest of 1 pricent while in the female there is a 20 per cent reduction.

The total removal of the sex glands tends to mercuse the re emblance between the two sexes or, in other words to reduce the differences in the a secondary characters which, in the normal animal are modified according to sex."

Function of Interstital Cells -- The following facts seem to how that the development and maintenance of the ex life in the vertibrate male is primarily a function of the interstitud cells

- 1 In eryptorchidism there may be complete atrophy and absence of spermatozoa and apermatogonia, but, if the interatiful cells are present, see structures and sex functions remain normal. These makes are of convey stories.
- 2 After ligition of the was deferent, the spermatogonia suffer gradual and finally complete atrophy but as long as the cells of Leving are mased see life remains summpaired. Extripation of such modified testes brings on the usual sequelie of castration. Steunach claims that ligition of the vas induces hypertrophy of the Leving cells.
- 3 Testicular transplants maintain sex lift as long as sufficient quantity of the interstital cells continues to live interpetive of the degeneration of the sperm producing elements, and extripation of such partially degenerated grafts brings on the typical symptoms of castration

The control of the sex life of the male by the cells of I evidig is evidently a himmoral one as a denervited testis and a te tienlar transplant in another organ and thus outside of its normal sensory nerve relations functions for a time like a normal testis except for fertility. This is also indicated by the fact that men with complete transverse lessons of the spinal cord, provided the training and great enough to cause mirked

and feather colors, horns, etc.) In some of the invertebrates the castra tion has no effect on the body male characters. In species where horns are not a sex character, castration has no effect on the horn growth

2 It delays the ossification of the long bones, and the union of the

sutures of the skull

3 It leads to certain changes in the endocrino glands, the most notable being the enlargement of the hypophysis, and the adrenal cortex, and the retarded involution of the thymns. The growth of the thymns is said to be diminished. But Moore has recently reported that castration in the voung guiner pig decreases the growth of the hypophysis, the adrenals, and the spleen, and causes increase in the size of the thyrothe Evidently this aspect of goingl function requires further investigation.

4 The rate of metabolism is somewhat lowered, with a tendency to adiposity, vasomotor irritability (sympathetic system) is said to be

decreased

- 5 The most notable mental change in the eastrated male is absence of the boldness, pignacity, and viciosiaess of the normal male, particularly during the breeding season. In this respect the costrated male may be said to resemble the cluld or the female. This comparison must not be curried too far. Hikmet and Regnault say of the cunnichs of Constant nople that "they are avaricous, stupid, credibious, illegical, boktimite, fanstical, fond of children and animals, faithful in their affections but lacking in courage." But the reader will admit that this characterization will fit many a man with instact and normal testicles.
- 6 There is little or no development of the sex urge in its various

When the testes are removed in the adult male the most notable changes induced are

- 1 Sexual impotence and diminution or loss of sex urge
- 2 Tendency to atrophy of the secondary male characters
- 3 Lowered rate of metabolism and tendency to obesity

The striking specificity of the influence of the testes on organs is shown in the case of the growth of horns. Horns are modified skin structures apparently identical in all manuals having these organs. Never theless in species where the horns constitute a specific male thartetry castration prevents their development while in the species where the horns are common to both seves, castration has no effect on their growth

Thus we see that atrophy or extirpation of the testes leads to impair ment and final loss of all structures and functions specific for the sex life of the male, but it does not bring on any serious disturbance of other functions. There are no sequelze comparable to those of the artificial and feather colors, horns, etc.) In some of the invertebrates the castra tion has no effect on the body male characters. In species where horns are not a sex character, eastration has no effect on the horn growth

2 It delays the ossification of the long bones, and the union of the

sutures of the skull

3 It leads to certain changes in the endocrine glands, the most notable being the culargiment of the hypophysis, and the adrenal cortex, and the retarded involution of the thymns. The growth of the hypophisis and to be diminished. But Moore has recently reported that cristration in the voing guiner pig decreases the growth of the hypophysis, the adrenals, and the spleen, and causes increase in the size of the throad Evidently this aspect of gonad function requires further investigation.

i The rate of metabolism is somewhat lowered, with a tendency to adiposity, vasomotor irritability (sympathetic system) is said to be

decreased

- 5 The most notable mental change in the eastrated mile is absence of the boldness, pugnacity, and viceousness of the normal male, princularly during the breeding season. In this respect the castrated male may be said to resemble the child or the female. This comparison must not be carried too far. Hikmet and Regnault say of the councils of Constant nople that "they are avarieous, stupid, credulous, illo, cal, obstinate, fanatical, fond of children and animals, faithful in their affections but lacking in courage." But the reader will admit that this characterization will fit many a man with mitact and normal testicles.
- tion will fit many a man with intact and normal testicles

  6 There is little or no development of the sex urge in its various
  manifestations.

When the testes are removed in the adult male the most notable changes induced are

- 1 Sexual impotence and diminution or loss of sex urge
- 2 Tendency to atrophy of the secondary male characters
- 3 Lowered rate of metabolism and tendency to obesity

The striking specificity of the influence of the testes on organs is shown in the case of the growth of horns. Horns are modified skin structures apparently identical in all mammals having these organs. Never theless in species where the horns constitute a specific male character, eastration prevents their development, while in the species where the horns are common to both sexes, castration has no effect on their growth

Thus we see that atrophy or extirpation of the tistes leads to impair ment and final loss of all structures and functions specific for the sex life of the male, but it does not bring on any serious disturbance of other functions. There are no sequelse comparable to those of the artificial animals. Lown states that grung testicular extracts to young capons induces development of the male characters. Walker was mable to prevent the atrophy of the prostate in estrated dogs by injection of testics extracts. Walker and Riddle have reported that administration of testics under extracts for female animals (chicken procons) tends to produce male characters and male behavior. It has been demonstrated by Main the memer that in castrated mule frogs the characteristic development of the forelegs at this breeding, season can be included by it stee activates.

Climeal—The testes, variously prepared was used by the ancient Greeks and the Hindus as an aphrodisace and tone. Its modern use in that direction datas back to Brown 'quirul in 1843' who administered extracts of the testes to him elf and thought be experienced a great augmentation of bodily and mental upor Zoth and Fregl using the ergograph, report some outdence of increase in mustular work after subcutations injections of the extract. Similar results would probably have followed the injection of any tissue extract. In many if the reports of the action of the extract on normal persons the element of suggestion was not controlled.

The work of Poehl and his associates with spermin was even more sen sational than that of Brown Sequard Pochlingurled perion is a general metabolic stimulant or catalyzer and reports good results from its use in the following maladies. Asiatic cholera syphilis erysipelas, delinum tremens gas (CO) poisoning chloroform and other poisoning impairment of heart and lungs optic atrophy hemiplegia, paralysis, catatonia, cholera hysteria, neurasthenia myelitis scura, marasmus, skin discases to phoid fever, toxic goiter, pulmonary tuberculosis diabetes mellitus, anemia and gout This is a good example of organotherapy running amuch! There is no evidence that any of these maladies are in any way related to hypofunction of the testes. So far as we know there is no evidence that castration lowers the resistance to infection or otherwise produces conditions favorable to the above diseases And par ticularly in cases of toxic goiter where the destructive metabolism is in creased to a degree not found in any other discase except high fevers any therapy which still further augments the metabolism is clearly contra indicated But others have recommended the use of testicle extracts in toxic goiter, diabetes, obesity, eczema, etc. (Jones, Friedlander Bauffe, Burghart)

Transplantation of the Testes—Transplantation of the testes appears to be only a temporary measure even under the most favorable conditions, as the graft is sooner or later completely to orbid, but as long as a sufficient amount of the tissue remuins aline the graft is able to custain exclife even when as in Nussbrum's experiment it is placed in the lymph sac. Wheelon and Shipley found that a te test true plant was not able to re-

mental and physical depression, from the beginning retain their inchination toward the female set, although they can no longer experience the scusations due to creetion and contast

Relation of Interstitial Cells of Testes to Cortical Cells of Adrenals, Hypergenitalism -I ion the field of hi tology and organogenesis, ou dence has been addreed to show that the cells of I evelig in the testes and the cells of the interioral or the cortical system arise from the same embryological inlage. This may be accepted is true, but it does not con stitute a proof that in their idult differentiation the functions of the c cells are identical or reciprocal. In timees are also related in the litera ture of tumors (hyperictivity) of the adrenil cortex producing sexual precocity in boys. This is significant, if true, and if there is no ext dence of premature development of the testes themselves. Tumors of the testicles may also unduce sexual precedity. However, it is clearly established that no other land in the body em assume the role of the interstitual cells in sex life. After castrition in a normal animal the other endocrine al inds either remain normal or undergo some hypertrophy These hypertrophies, even in the else of the adicual cortex, cannot be of compensatory nature, at least as regards the specific sex rolo of the testes, since they do not maintain sex life. If the hypertrophies are compensitors it must be in relation to some Leneral metabolic or detoxication function that the testes have in common with other endocrine lands

Chemistry of Testes—The nature of the process of or the sub time in the interstitual cells that su tains the male sex life remains unknown. Poochl claims to have related a substance from the entire testicle, having the formula C H₁₄N and called by him "sperimin". He reports that this sub tance is the physiologically active constituent of testicular extracts, and, injected hypothermically, it accelerates inclusibles may ack as a general physiological tome. Divon found an abundance of nucleoprotein, other products, organic bodies not affected by boiling, and nore, into sits in extracts of the testicles. Hermore reports the prevence of lipses and amylase in the interstitual cells. With the possible exception of Pool is sperimi, there appears to be nothing specific in these findings. Similar substances are found in all organ extracts.

From a series of very interesting experiments on mulo frogs, Nussbaum concludes that the testicular secretion rets primarily upon the nervous tissue as a tonic or a stimular, and the augmented or altered activity of the nervous thesis, in turn, sustains the sex life. This view is probably true in specific cases, but cannot be recepted as a complete statement of the situation.

Clinical and Experimental Uses of Testes Extracts—Lxperimental
—Boun and 'incel report that injection of testicular extricts into cas
trated guinea pigs prevents the atrophy of the inale characters. Accord
ing to the same authors this extract also accelerates the growth of the

tained Yet surgeons have reported successful testes grafts using testicles five days after extirpation from the donor

5 At present, the most that a testes graft can do even temporarily, is restoration of libido and copulation power with synchronous increase in metabolism. Other alleged effects on mind and body are probably due to suggestion. Fertility is not restored. Testes grafts are therefore, at present, a biological futility a catering by the surgion to the elements of sex decemenary or the other probably surgion.

#### Shamada

1 The specific sex characters and sex life of the vertebrate male are developed and sustained by hormones secreted by the testes. In the case of the mammals there are indications that some of three hormones begin to function in early embryonic life. The hormones that determine development to full sexual maturity are probably different from those that sustain sex life during full sexval maturity.

2 Complete removal of the testes either in vouth or after maturity prevents or abolishes sex life, but has no other significant or deleterious

effect physical or mental, on the individual

3 The only fields for rational organotherapy of the male gonads are the comparatively rare cases of strophy, disease, or accidental loss of the tates. The rather meager experimental and climical data on this point indicate that the administration of testicular extract by mouth or par enterally, does not instain sex life. It cannot of course, overcome sternity. On the whole organotherapy of the testes from present indications is sery limited and of little importance.

## THE PROSTATE GLAND

The prostate gland is a coondary male character undergoing atrophy on eastration and varying in size and secretor, activity with the activity or dormance of the testes. The prostate secretion mixes with the sperma toma and forms a part of the seminal filled. This prostatic secretion may be of importance in maintaining the mutrition and activity of the sperm

In these days of active microst in hormones, suggestions of internal secretion functions have also been made for the prostate. Macht reports that feeding prostate to tadpoles atmulates growth, and hastens meta morphosis. But this may be a dictary factor rather than an index of hormones. Feeding prostate gland to mammals has so far vielded no clear effects. Macht was unable to demonstrate any impairment in mental ability and nervous coordination in providate/omized rats. Reichel has desembed cells in the prostate gland similar to the Leydig cells in the

store the vasomotor irritability of castrated animals to its normal level, though there was some improvement.

Morris has reported an instance of a testicle transplant apparently stimulating a dominant testicular remnant so that it hypertrophicd into an apparently normal testicle. The patient had lost most of the testicles at the age of thirteen in a complication of minimps. The man, age twenty seven, at the time of the testicular transplantation, showed some effects of castration.

We have now a great body of data, experimental and clinical, on testile transplantation (Stemach, Sand, Moore, Lespinasse). The set entific interest and biological significance of the problem is great. The clinical interest is concerned with the possibility of restoration of sexual potency with attendant physical and mental stimulation ("repurention") in old men, the possibility of rejuvenation of partially atrophic testiles in volunger men, and thus the restoration of male fertility, and the possibility of counteracting the alleged physical and mental letbargy and anatomic stigmata that follow the loss of the testes in boxs. The clinical work in testes transplantation has been further stimulated by the universal failure to counteract testes deficiency (interstitual cells) by feeding testes preparations in any form. The following facts seem established

- 1 If adequate surgical technic is used a fairly high percentage of takes" is secured both from autotestes and heterotestes transplants, whether the graft is placed in the scrotum, under the skin, or in the peritoneal cavity
- 2 Practically in every case only the cells of Leydig survive, and the length of survival is variable. In rate and guinea pigs testes grafts may live at least six months. The most favorable clinical reports indicate a survival of from a few months to two years, but these cases have not been checked up by histological study of the graft. We have only the patient's own word for his sex potency, and this is not always reliable at pre-ent there is no evidence that the testes graft can live through the normal period of male adole ecnee. Why a testes graft once adequately asseularized undergoes atrophy within such a short time is not known.
- 3 There is no reliable evidence that testes transplanted from goats or monkeys to man ever become vascularized and survive. The reliable evidence is all to the contrary. At present this type of surgery, when done for pay with definite promises of results is quackery, and does the honest medical profession much harm. In this business the surgeon is the monkey, and the patient is the goat.
- 4 The question of how long a human testicle will survive after it is removed from the body and used for grifting is not settled. Most main malian organs, particularly glands, die within a few hours after excision, probably from asphyxia, even when assepsis and low temperatures are main

tained. Yet surgeons have reported successful testes grafts uning testicles fits days after externation from the donor

5 At present, the most that a testes graft can do even temporarily is restoration of libido and copulation power with synchronic mercases in metabolism. Other alleged effects on mind and body are probably due to suggestion. Fertility is not restored. Testes graft are therefore, at present a biological fulfility a catering by the urgion to the elements of sex degeneracy or nour respects.

### SUMMARY

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testes handaleon has reported hypertrophy of the mammary glands in two seventy year-old men, following prostatectomy. This is at least not I frequent result of prostatectomy, as this is a common operation in mod ern surgery, and we are aware of no reports similar to that of handaleon

During the active sex life of the mile, the prostate gland depends on the testes, nevertheless, there is frimently a hypertrophy of the prostate in old men when the testes functions are definitely on the decline. This is an actual contradiction, since the prostatic cultracment in old men is clandular

### SUMMAPE

There is, at present, no reliable evidence that the prostate farmshes an internal secretion, since prostatectomy induces no demonstrable defects. prostate feeding is without influence, at least in municils, and nothing even remotely resembling a hormone has so far been found in this gland

The use of prostate material in organotherapy is therefore with ont any basis, at present. The pseudomedical literature furnishes, of course, testimonials of cures of a variety of ailments from the growing puns of childhood to postoperative meluncholia, and the drug houses fur nish prostate extract. Under these conditions, it is up to the doctor to furnish the antidote of common sense

## THE PINEAL BODY

The pineal body is an engination of the embryonic neural tube It is composed of ependynul cells in a framework of neuro ha and con nective tissue. According to comparative anatomy, the pineal body represents the vestige il remnant of a median eye, perhaps functional in some species of reptiles, but its histological structure, at least in youth the effects of pineal tumors in man, as well as some of the experimental physiology of the organ in birds and mammals, indicate that it may be a gland of some importance, at least during pre adolescence ological importance is, however, not yet clearly established

In man the pincul body continues to grow until the ago of seven to eight years, when atrophy or involution sets in, so that in the adult the pineal body is made up mostly of connective tissue cells and the so-called "brain sand" Ibe average weight of the gland in man is 0 22 gram It takes 25,000 pincal clauds of culves to make up one pound of dried gland substance (McCord) The size and structure of the pincal body appears to be identical in males and females

Jordan has noted the great abundance of the blood supply to the organ The presence of sympathetic nerve fibers in the pincal body has also been asserted (Cajal)

Injections of Pineal Extracts - The intravenous injections of ex tracts of the pineal gland have revealed no action of specific physiolo, ical unportance at least for the errollation (Tordan and Lister Horrey McCord) In large doses, pincal extracts lower the blood pressure but this is not specific

McCord states that subcutaneous injections of sterile nineal gland (young calves) into young guinea bigs three times weekly has a marked

stimulating action on growth

Extremation of the Pineal Body -According to Budl Faner and Bocse, and Dandy, extirpation of the organ in adult does or in rabbits (young or adult) produces no demonstrable effects Because of the loca tion of the gland, most of the operated animals die within twenty four hours of hemorrhage, brain mury and shock. But the few that survive the operation trauma are said to remain normal Both Sarteschi and For report very different results from pinealectomy in youn, chicks rabbits, and rats According to Foa the operation has little or no effect m females, except a temporary retardation of growth. In the males the extirpation of the gland leads to precocious sexual maturity. This acceleration of sexual maturity was also ob erved by Sarteschi in operated male pups and rabbits. Horran reported a slight receleration of the growth of the testes in pineakctomized guinea pigs No demonstrable of fects were produced in the operated females The most important and conclusive work in pineal land extirpation is that recently reported by Dandy on young dogs Dandy extirpated the pincal body in pups (male and female) ten days to three weeks old and observed their body growth sex life, and mental behavior for eight to fifteen months after the opera tion In no case did he find sexual precocity or indolence adiposity or emacation, somatic or mental precently or retardation. Dandy concludes that the pincal body is not e sential to life and seems to have no influence on the animals well being at any age

Feeding Pineal Material-McCord reported that feeding pineal glands to young animals (guinea pigs) accelerates growth and hastens sexual maturity, both in males and females There was no tendency to gigantism The pineal fed animals simply attain adult stature at an earlier period. According to McCord, these effects are most striking when the pincal organ obtained from youn, annual (calves) is fed. Ho kins and also Sisson and Timey on the other hand, obtained in attree results from feeding pincal material to rats VcCord and Allen reported a peculiar contraction of the skin pigment in tadpoles fed with pincal ma ternal They propose this reaction as a quantitative te t of pine il extracts Pineal subtance some to basten reproduction in some unicellular

Dana and Berkelev claim that feeding or injecting pineal gland to 'lackward' children improved their mentality ilthough growth of the body was not accelerated Goddard ond Cornell extended these tests to a large number of backward children The results were negative.

Pineal Tumors —Tumors of the pincal body in the joing bare frequently been associated with acceleration of growth (mental and physical melinding precocious adoliscence) The syndrome is designated 'macro genitosomia price't. Cielic via is prisent, piobably due to brain injuries

The interpretation of the body changes in the case of pineal tumors in the sense of hypo activity or hyperactivity of the gland is very un certain, especially in view of the contradictory results of animal experiments. McCord reporting that pineal feeding produces the identical results described by Foa and Sarteschi as following complete extripation of the pineal body.

There is at present no rational or useful pineal organotherapy. The contradictory effects reported from work on animals and the uncertainty of pineal dehections in main must be cleared up before we are justified in trying pineal organotherapy in the climes, even experimentally. At present there is no rehable evidence that the pineal body is a gland, or a gland of any importance. The bodily changes in cases of pineal tumors may be due to involvement of the midbroin.

### THE THYMUS

Physiology—The thermus develops in the embryo from the epithelium of the third branchial ponch. Its origin is thus similar to that of the thyroid and the parathyroid. We have seen that eccessory throads and parathyroids are frequently found embedded in the thirmus tissue. The thymus is primarily an origin of fetal and preadoliseent life, as in normal men and animals it undergoes involution at puberty, and is finally replaced by connective tissue, lymphoid tissue, and fat. But it is reported that the thymus of birds does not indergo involution at sexual maturity (Soh) Jaisen reports 'accidental involution' of the thymus in starvation and malnutrition. This is probably not a true involution but merely the great reduction in weight suffered by this origin is fasting. The relative size of the thymus is greatest shortly after birth.

The thymus contains several types of cells The outer or cortical portion of the gland is made up of lymphoid cells According to Danschaloff, Hammar and others, these small cells of the thymus cortex differentiate into the various forms of reukocytes of the blood and lymph. Hoskins has pointed out the parallel between the decreasing percentage of weight of the thymus in relation to body weight, and the dicrease in lymphoid test in the blood from hirth to adolescence. The central portion, or medulla, is composed of a few lymphoid cells and the prenhar "corpusates of Hassall," composed of nests of epithelial cells. The function of the Hassall's bodies is not known

The specific role of the thymus is still very obscure and most of the intrestigators question whether it should be classed with the endocrine glands. The organ is not necessary for life. The facts definitely established are the involution of the organ at puberty and the delay of this involution by eartration.

Henderson states that early castration accelerates the growth of the thymus and prolongs or delays involution. Involution of the thymus occurred especially rapidly in animals used for breeding purposes. On the

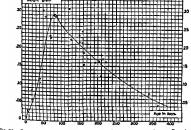


Fig 22 -- Chart Showing the Weight of the Thymus of the Albi o Par According to Age. The observed weights are represented by 2.9 males and 07 females. (Halai)

other hand Paton states that removal of the thymus in sexually immature animals led to a rapid growth of the testicles

From such experiments and observations it has been concluded that the thymic exerts an inhibitory action upon the development of the testes and that the development of the testes has an accelerating effect upon the involution of the third particles and that the development of the testes has an accelerating effect upon the involution of the third involution of the third involution of the growth of the sexually immature animal the removal of both retards growth. This has sexually immature animal the removal of both retards growth. This has been established for the overries and thymns of the female. After removal of one the other can compen ate for its loss, and in doing so may indergo a more rapid growth or, in the case of the thymic may be priest for a longer period. Further evidence of a relation between the

thymus and sex glands has been sought in the first that the ovaries are sometimes enlarged in stitus lymphaticus (Birtel ind Herrinaum)

The relation of the thymus to growth was studied by Busch and others my sound animals from which the thymus was removed. Such animals are said to show delayed growth and dimunshed intelligence. The changes in the bones were especially marked, these showed deficient ossification Busch, and Paton also, a ported that the peripheral across system showed in mercased exertability, as determined by galaxies stimulation, and Paton suggests that there is a close relation of the thymus and the parathyroid functions.

Klose and ilso klose and Vogt state that if the thynins is removed from puppies about ten days after hirth, there is a latent period of two to four weeks, followed by a condition of adiposity for two to three months, then eight an aid a condition resembling athoey, and death in 'thismic cont' after three to fourteen months. They say that extripation of the thynins in infinite is followed by sainthar results. They consider the gland to be in important origin in early life. They also state that the bones of an imals deprived of the thynins have only about half the normal amount of calcium. They consider the bone and other changes to be done to red mitoxication, and that one of the functions of the thynins is to milibit the formation of or to nutrialize in excessive formation of each, probably nucleic acid. I sentially similar is called were reported by Mitt.

But Nordmann states the removal of the thynnas shortly fiter birth in dogs have no effect on growth or other physical conditions. Hammer found that thymectomy in froes produced no demonstrable effects, and Allen has shown that thymectomy in amphibian tadpoles as without in fluence on growth and mixt morphosus. Vorgulis and Gies report that the calcium content of the bones and teeth of thymectomized rate remained the same as in the normal controls, buce, they contend that the thymis has no definite necessary influence on bone growth. More recently extensive and careful studies on thymectomy in rats and young dogs have been reported by Pappenheimer, Park, and Park and McChire. The results were no gative.

The experimental results from thymectomy are, therefore, very contradictory. howing reports a resection of the thymas in a nuncimental old child, followed by severe and prolonged rachits. There is no evidence, however, that the thymns re-ection was the cause of the rachits.

The thymns is often found persistent or enlarged in cases of Graves disease, especially in the secret forms. Capelle and Beyer believe that an internal secretion of the thymns aggravates the symptoms, especially the cardia of symptoms of the disease. They, as well is Pribrain, report improvement from thymictomy. Bircher stated that the implantation into animals of a pathological thymns caused symptoms of Graves disease, such as tachy cardia and tremors.

Rathford believes that the thymus produces an internal secretion of fecting nutritional processes especially in fetal life and early childhood, he believes that status lymphatiens is due to an excessive activity of the thymus. Firedlander stated that exposure of the thymus to Roentgen rays carees dimmintou in the size of the spleen and lymph noles in status lymphaticus. Nordmann thinks that some cases of toxic goiter are due to abnormal functioning (hyperplasia) of the thymus. But feeding through cuttin rabbats is without effect (Curlson)

Guidematsch and Lenflar_{s,t}, found that feeding thisms accelerates growth of fin, tadpoles. This has been dained or ascribed to the food at such (Uhlenhuth). Simmen claims to have produced a thinetown serum (thymolisus), the injection of which produces the same risults as thimeetomy. Out and sort report that thisms carriest have a galacta sque action. This is erroneous. Phileibinth reports that feeding cities thim as a chainmade tadpoles induces the time and inhibits mechanisms. He interprets this as establishing an internal secretion (toxic) in the terms, this secretion being destroved by the parathyroids. This in terpretation seems at present far fetched. Subcuttuous injections of thim is substance into jouing rabbits seem to produce no specific effects (Downs and Fddy).

Pathology — In primary rile of the thymu in the discale syndromes frequently associated with an enlarged thymus (status lymphaticus thymic death, toxio gotter), is still unknown. There is no char evidence that hyperfunction of the thymus is an etologic factor although the upparent sunfection of the thymus have best interpreted. More thymica is not due to inchanced interference with circulation and respiration (Hammar). Manimerus has been ascribed to hyperthymism. (Browning). Bergstrand has described two cases of simul

tancous thymic and parathyroid hyperplasia

Therapeutic Uses of Thymus Extracts — Il runns his been administration many diseases (gont simple and tone coite, merasums, returned growth, infantilism, rheimatism authritis, elloresis acrome alia, 1ddi son disease, etc.) Mikhibez reports favorable results from thomas fred in in simple and toxic poster. Uncertain or negative results from the administration of thymus in coiter (sample and toxic) were reported by Mackenzie, White Parker and many others. But thinus feeling, has no citicus on experimental hypothyroidism (rabbits) where all conditions can be controlled.

Anthan administered thymnis to rachitic children in doses of from two to four fivegrain tablets (each tablet apparently containing dry gland equivalent to five grains of the fresh gland) three times a day for long periods. In one lundred and eighty six cases to ited, practicelly all improved. When the thymnia is conscientiously taken for \(^1\) to \(^1\)

tracts The injection of the spleen extract has no influence on the resistance of the orde cells to hemolysis. In some cases the administration of the spleen extract induced a slight and temporary loukocytosis, but this was also noted in the case of extracts of other organs. Arumbhair and Musser noted that the constant increase in red cells in the peripheral circulation after injection of spleen, in view of the tendency to anemia following splenectomy, suggests that 'the spleen may normally exert a stimulating effect input the formation of rid cells in the bone mar row."

Feeding spleen or spleen extracts to anumals, even over a long period, his no effect on tho blood picture, and fails to prevent or diminish the anemia following splenection; (Krumbihar and Muser). This is a fact of great practical importunce for possible spleen organotheraps in man, where repetited subcutaneous or intriperitonial administration of a crude tissue extract is of contres, out of the question. We see that on the basis of uell controlled animal experiments we cannot hope to control spleen deficiency or induce specific spleen functions by feeding spleen or spleen preparations.

Flexuer has reported various toxic effects from spleen extract admin intration

Hypofunction or Dysfunction of Spleen in Splenic Anemia Hemolytic Jaundice and Hanot's Cirrhesis - There is some destruction of crythro eytes in the normal spicen, and possibly some degree of control by the spleen of red marrow, blood plasma, and erythrocytes so that the rate of crythrocyte production and bemolysis strike a balance in the normal am mal In splenic ancmia and hemolytic jaundite there is usually enlargement of the spleen, a decrease of resistance of the crythrocytes to hemolysis and an actual increased rate of crythrocyte destruction, as shown by the output of urobilino, en, urobilin, and iron in the feees Mchelvic and Rosenbloom report a case of hemolytic jaundice and splenome, aly with the crythrocytes showing a decreased resistance to hypotonic laking. The suggestion is made that this may be due to a decrease in the cholesterol content of the blood Robertson states that in permicious anemia the erythrocytes of the splenic voin show less resistance to laking agents than those of the general circulation Fatracts of the normal sphen have, how ever, no hemolytic action in titro (Krumbhaar and Musser) This is also true of spleen extracts from permicious anemia patients (Robertson) Ex tirpation of the spleen in spleme anemia appears to restore such patients to normal health, either through the absence of the actual hemolysis taking place in the spleen, or to some increased resistance in the erythrocytes to laking agents in the blood itself

After an examination of all the cases so far reported Miller concludes that "splenectomy is undoubtedly curative" Gerdes does not appear to be so sure of this But the improvement following splenectomy shows clearly that the byperfunction or dysfunction of the spleen is the primary cause of this type of anemia

The Spleen in Permicious Anemia —The relation of the spleen function to permicious anemia is less definitely established. Most observers agree that splenectomy in permicious anemia usually induces a temporary simulation of the blood forming organs, and hence a transient improvement of the anemic condition but 'm no case can it be said that the splenectomy produces a cure of the disease (Livimbhaar). Blood transfusion has a similar stimulating action, but less marked and somewhat more transitory (McClure Lee Minot and Vincent). There is then no evidence that the spleen functions are primarily concerned in permicious arems.

There is no satisfactory explanation of the opposite effects on the blood of pleneetomy in normal persons and animals (temporary anemia) and in patients with permeious anemia (temporary improvement of the blood)

Therapeutic Uses of Spicen and Spicen Extracts—The use of spicen extracts in constipation and intestinal stasss as a specific stimulant to gastro intestinal movements (Zuelzer) is referred to in the section on Duo deal Mucosa.

Spleen extracts have also been u ed in anemia and chlorosis in ma lans in menorrhagia and in hemophilia. No reliance can be placed on the favorable results sometimes noted in these maladies in view of recent work on the relation of spleen to anemia and the further fact that spleen and spleen extracts given by mouth have no specific action on the organ im. The anemias that are blieffled by organic tron preparations will naturally, show improvement on spleen therapy as the spleen is rich in ron. But this is furing of food therapy, not organicitary as this action is not specific for the solven

The most strikingly irrational use of any organ or organ extract in therapeutics seems to be that of sphene actuate in tuberculous. Harrowner and others have advocated and clumed to have proved that feeding sphene is be repeated in tuberculouss? There is no basis for such therapy of tuberculouss either in the physiology and pathology of the sphen, in the body of the tubercle bacillus or in the natural history of tubercular infections. As a matter of fact I ewis and Mar₁ct state that sphericetoms in mice increases the resistance to tuberculosis while feeding sphen has the opposite offect.

#### SUMMARY

There is at present no cudence that the spleen secretes or stores hormones or that hypofunction of the spleen causes disease hence there is no rational or useful organotherapy of the spleen.

# THE GASTRIC AND DUODENAL MUCOSA

Secretins -It is well established that acids or acid chymo in the duodenum is a stimulus to the secretion of panereatic juice and hile Bayliss and Starling macerated dnodenojemnal inucosa in 0.4 per cent hydrochloric acid, neutralized the mixture, and filtered A few cubic centimeters of the filtrate injected into a vein invariably produced secretion of pancreatic juice. The substance in the extract stimulating the panereas was called 'secretin" The secretin has since been prepared by other methods, and from a variety of plant and animal tissues. It is thus, not specific for the duodenojejunal mucosa It has not been prepared in pure state. All secretin preparations seem to have vasodilator actions. Popielski attributed the action on the panere is to the vasodilutation. This 13 probably not the primiry or essential factor. Luckhardt has shown that the 'secretin" of Bayliss and Starling is probably an artefact or drug rather than a physiologie agent, as this secretin on hypodermatic injection stimulates the panereas and the gastrie glands, while acid in the duodenum stimulates the panereas promptly and the stomach not at all, or after a latent period of thirty to sixty minntes. Furthermore, prolonged action of acid in the duodemim finally fails to stimulate the pancreas. This is not due to fatigue of the panereas itself, nor to exhaustion of the duodenal mincosa, for this mucosa on send extraction yields as much 'sceretin" as the resting mucosa. It is therefore clear that if there is a hormone or 'secretin" mechanism connecting the panereas and the duo denum, this hormoup (secretin) has not yet been extracted from the duo denal mucosa The simplest explanation of the stimulation of the pan creas by acids in the duodenum would be a local nervous reflex, but that this does not account for it completely seems to be shown by the denervated intestinal loop experiments of Bayliss and Starling, as well as by the even more crucial transfusion experiments (Wertheimer, Hen riquez and Halhon), and of cross circulation (Fleig, Matuso)

To the extent that the sceretin passes into the lumen of the gut it is a wasted sceretion and is quackly destroyed by trypein and by pepsin hydrochloric acid digestion, and, even in the absence of these digestive ferments, secretin is not absorbed in active form from any part of the gut divide parceas and the live. Subcutaneous injections of secretin are also practically without effects. In consequence of the instability of secretin the commercial preparations of scretin so far placed on the market (veretogen, duodenin, also the secretin of Beneridge) contain, as a rule, no prosecretin or active secretin (Carlson, Lebensohn, and Pearlman)

Secretin has not yet been prepared in pure form. It represents at present a mixture of substances, probably including cholin. Repeated

intravenous injections of secretin are therefore highly toxic producing collarsa (Starling)

Secretin Organotherapy—It is obvious that a rational and useful secretin therapy demands these too fundamental condition. (1) Secretin must be a normal or physiological substance and deficiency of secretin must be an important factor in the etiology of the disease. (2) Secretin must be also in important factor with etiology of the disease. (2) Secretin must be able to influence the pancies and the liter when given by mouth for it is not safe to introduce it repeatedly into the tense of human beings. Nother of these two conditions has been estib-

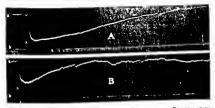


Fig. 3—That the Sidney to Particular Constant Desirection of Somethy at Tun.

Charmed Guess De Junder 1, by their ameliesam cannols in the pancretic duct
a car told blood 2 gain the particular of flow of paner size junce in drops. Time 2s
in nutes. Trainer A interaceous inpit into a flow the centimeters secreting
pared fresh from dega disodensi mucosa) at x Training B intras none injection
(at x) of 10 cubic c nitmeters of the same ret n as in Training A after being
digetted in normal human gastrie juice at 37 C for - hours. (Carlion Lebensol n
and Pearlinas)

lished. Despite this secretin, or alleged secretin has been used in the therapy of a variety of diseases

Diabetes Mellitus—Voore Educ and Mraus were the first to suggest a therapentic value for secretin, having obtained favorable results with secretin administration in diabetes. They argued that the internal secretion of the panerias may be stimulated by secretin and that some cases of diabetes may be due to lack of this necessary secretiant. Owing, to the importance of the question, their amouncement was followed quickly be numerous investigations by other observers.

I reviously, Spriggs, at the sugge tion of Starling, had tried intravenous injections of secretin free from depressor substance in a diabetic patient, and had obtained negative results. Moore Edic and Morain gave their secretin by mouth over long periods. Of the five cases cited in

# THE GASTRIC AND DUODENAL MUCOSA

Secretins -It is well established that acids or acid chymo in the duodenum is a stimulas to the secretion of pancreatic juico and bile. Bayliss and Starling in recrated duodenojejunal mucosa in 04 per cent hydrochloric acid, neutralized the mixture, and filtered A few cubic contimeters of the filtrate injected into a vem invariably produced secretion of pancreatic juice. The substance in the extract stimulating the panereas was called "secretin" The secretin has since been prepared by other methods, and from a variety of plant and animal tissues. It is, thus, not specific for the duodenoje mal mucosa. It has not been prepared Ill secretin preparations seem to have vasodilator actions Popielski attributed the action on the panereas to the vasodilatation. This is probably not the primary or essential factor. Luckhardt has shown that the secretin" of Bayliss and Starling is probably an artefact or drug rather than a physiologic agent, as this secretin on hypodermatic injection stimulates the panereas and the gastric glands, while acid in the duodenum stimulates the panereas promptly and the stomach not at all, or after a latent period of thirty to sixty minutes Furthermore, prolonged action of acid in the duodenum finally fails to stimulate the pancreas This is not due to fatigue of the panereas itself, nor to exhaustion of the duodenal mucosa, for this mucosa on acid extraction yields as much secretin' as the resting mucosa. It is therefore clear that if there is a hormone or 'secretin" mechanism connecting the paneress and the duodenum this hormone (scerctin) has not yet been extracted from the duodenal mncosa. The simplest explanation of the stimulation of the pan ereas by acids in the duodenum would be a local nervous reflex, but that this does not account for it completely seems to be shown by the denervated intestinal loop experiments of Baylass and Starling, as well as by the even more crucial transfusion experiments (Wertheimer, Hen riquez and Hallion), and of cross circulation (Fleig, Matnso)

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In 1908, Zuelzer proposed, on the basis of badly controlled animal experi ments the novel theory that there is a specific gastro-intestinal motor hormone, elaborated in the intestinal mucosa during direction, absorbed into the blood and stored in the spleen. Hence, the spleen was held to contain more of this alleged hormone than any of the other organs was claimed that an extract of spleen and intestinal muco 1 ( hormonal ) on intravenous or intramuscular injection produces normal intestinal peristalsis in man and animals without any injurious side effects. The extract was tried for a time especially in Cermony, in cases of chronic constipation, and postoperative intestinal stasis. It was soon found that miratenous injections of this extract in nationts may cause shock, col lan and sudden death And the more carefulls controlled investigations of Dittler and Mohr Sabatowski Schlagenweit und others showed that intramuscular injections of the extract have little or no action on gastro intertial motility, while the intravenous injections produce the general toxic symptoms characteristic of all it sin extract. Hence there is no specific or physiolo-wal motor hormone in the duodenal and spicen ostranta

After careful perusal of the entire hormonal literature we are impressed with the uniformly favorable results first reported by Zuclzer and a host of other climicians in two important case, namely, chronic constipation and postoperative intestinal stasis. These results were un doubtedly due to suggestion and dictated by uncritical enthusiasm, faith and hope in a new remedy When crucial judgment returned, hormonal was speedily found not only wanting but dangerous The 'hormonal' therapy had no basis in physiology or pathology. It was not based on well-controlled experiments on animals. So after a brief popularity with the credulous climeian it pas ed naturally to the therapeutic bone yard Hermonal' cannot do anything with ga tro inte tinal motility that can not be accomplished, and with greater safety by such drugs as pituitriu pilocarpin, or eserin

In a recent series of investigations, Le Heux has advanced the theory that cholin in the wall of the gut constitutes the motor hormone for gastro-intestinal peri talsis This view is accepted by Magnine But tholm is a constituent or cleavage product of the pho plantids of all animal tissues. Cholm in the blood is increased in case of degenerating nerrous tissue, but there is no evidence that this is accompanied by in testinal hyperperistalsia huhlwein has hown specifically that the in testinal stasis during and following anesthesia is not accompanied by a decrease of cholin in the intestinal wall

It present it is neither safe nor expedient to use a toxic substance like cholin hypodermalically to control motor paralysis of the gut

Other Possible Hormone Functions of Intestmal Mucosa -The work of Draper and of Whipple and his collaborators on duodenal extirpation their first paper, two were negative. The third was that of a man aged twenty five, who received daily 30 cc of secretin after a latent period of three weeks, the sugar suddenly fell, and after four months the urine was sugar five. Six months later a relapse occurred with the development of phtheirs and death. The other two patients were 1 how aged seven and a girl aged mine whose urine in from three to the weeks became significant for during secretin treatment, in spite of severe diabetes. One of the epa durints later relapsed. Bainfirdge and Beddard gave secretin 1 thorough trial in three cases with negative results, and are disposed to attribute the risults of Moore to dieting. Dikin and Ran om cited one case, eertin being given for twelve weeks, with negative Tostics, Foster, nine cases, all negative. Charles, three cases, all negative. Moore, Edie and Obrain, in a later paper, report a large number of cases tried with the majority of results negative, though in some cases an improvement in the digestion, and in certain cases an increase of weight was noted.

One method of testing, the basis of Moore's theory would be by examining the prosecretine content of the intestine in diabetes. Bainbridge and Beddard found, in the paper referred to, that from five of the six cases of diabetes examined postmortem, little or no secretin could be prepared, but in a sub-equent report of screen cases they found only one in which the secretin obtained was sently. The failure to obtain secretin in some cases they claim is probably due to the rapid postmortem degeneration of diabetic tissue. Lians, in Starling's laboratory, stated that in dogs made recently diabetic by total paineractectomy, but little secretin could be obtained. Hedon and Lisbonne and Pemberton and Sweet, report, on the contrary, that the duodenium of diabetic dogs is rich in presecretin. Bainbridge and Beddard, working on a diabetic cat, likewise found prosecretin to be present in normal quantity.

Digestive Disturbances—Enriquez has proposed that deficiency of pure guess Beckridge reports the nsc of secretion in ploton stenous, pan ereatic insufficiency, cirrhosis of the liver, colonic stasis, in gastro-enteros tomy and short-circuiting of the meetings. Harrower advocated the use of secretin for a large number of malades

Alleged Gastro intestinal Motor Hormone of Mucosa Hormonal, income than twenty five verts ago that natra venous injections of usawe extracts cause a temporary into tinal peristalvis, defectation comitting, etc., probably due to asphyxia from the greatly lowered blood pressure besides a number of other untoward symptoms. In 1904, Henriquez and Hallion showed that by treatment of strips of gut with Ringer's solution or distilled water a substance may be extracted which stimulates contractions in another intestinal strip.

Similar results were observed when the extract was injected into normal intact animals. This stimulating action is prevented by atropin

#### SUMMARY

- 1 The substances "gastrin and screetin are drugs not physicological mechanisms or hormones. They are ineffective when administered per os and cannot with safety be given parenterally
- 2 The gastric and duodenal anneosa may produce hormones that specifically regulate the activity of the panerea the gastric glands and intestinal motility. These hypothetical hormones have not vet been obtained in extracts of these organs nor has it been shown that deficiency of these hormones produces a disease.
- 3 We have therefore no rational or useful organotherapy of the gastro-intestinal mucosa.

### THE BLOOD

Blood Transfusion—The normal blood contains all the substances (nutrients, enzymes, hormones immune bodies etc.) increasary for the proper functions of all the organs so far as thest are exchanges between the tissues. Theoretically it ought to be possible to administer all hormones to a patient by the transfusion of normal blood but experiments have shown that the hormones of the thiroid the pancreas, the adrenal, the parathyroid are present in the normal blood in such infinitesimal traces or are so quickly destroyed and used up that blood transfusion in cases of hormone deficiency has proved of no practical value. Another reason for the failure of transfusion as a general hormone therapp, is the difficulty of transferring enough of the normal blood to the patient, with our previously draining the patient of the greater part of his own blood, and without endangering the donor. The "00 to 600 ca. usually transferred an blood transfusion of adults is too small a preentage of the total blood.

Considering blood as a tissue or organ, blood transfusion is tirtually organ transplantation. The blood is the ideal organ for transplantation from the aspect of surgical technic as there are no nervous and viscular connections to be considered, and in compatible bloods no destructive fuzzines to be eliminated. But from the physiological aspect we can hope for less permanent results from transplantation of blood than in the case of any other organ. The equilibrium of the blood both as to corpuscles and plasma constituents is a dynamic, not a static one and depends on the activity of the other organs. The effects of blood transfusion are, therefore, necessarily temporary, and the not satisfactory results are obtained in case of temporary need, as in hemorrhage carbon monoxid possoning etc.

and duodenal ob truction has suggested hormone functions of the duodenal mucosa other than those concerned with secretin and enterokmase Matthews claims that exterpation of the upper part of the diodenum in the dog invariably leads to death within three days, bence, he concludes that the duodenum is as neces are for life as the adrenals or the para thyroids, presumably through hormone function. But others have dem onstrated that animals live indefinitely after duodenal extirpation (Min Lowski, Drigstedt, Moorehead, Mann) Draper reports that feeding duodenal mucosa to dogs with duodenal obstruction or a closed duodenal loop lengthens the life of the animal somewhat, but fails to prevent death The e experiments by Draper are not convincing Whipple reports the secretion or production of a toxic substance (protein split product) in clo ed intestinal loop and successful immunization of dogs against this toxin Drag-tedt and his coworkers have demon trated that the toxins of intestinal obstruction or closed intestinal loops are developed by the putrefactive bacteria acting on the food and secretion proteins in the gut, The experimental work so far has yielded nothing in the way of hints of useful duodenal mucosa organotherapy of intestinal slasss and intestinal obstruction

The Gastric Mucosa, Gastrin—Shortly after the work of Baylas and Starling on pauercatic secretion, Elkins, by analogous experiments on the stomach, developed the theory that acids in the food, or the acid of the gistric juice acting on the muco-a of the pyloric end of the stomach, produce or hibernata a specific secretagogue (gastrin") in the blood, which activates the fundic glands. It has since been shown by a number of investigators that an active "gastrin" can be prepared by acid extractions not only from the gastric muco-sa, but from the mucosa of the entire alimentary tract, from the liver, the thiroid, various plant its uses etc. Gistrin—is not specific since it stimulates both the gastric glands ind the panceras. It has no effect when given by month—'Gastrin' is ordedity an artefact, not a physiological mechanism. Koch, Luckhardt and Kecton have shown that it is similar to but not identical with histanium and inlocarion.

The experimental work on the 'gastrins' has led a drug manufacturer to put gastric mucosa preparations ('gastrins'') on the market butters ed hy indiproved if not impossible, elains. The 'gastrins'' may some day be so purified that they may be impected hypodermatically in man, without injury, to inerca e gastrio secretion. But this is drug action, not organotherapy. Green hy mouth, gastric muco a or saftrin preparations are without effect except when given in such large quantities that the does practically amounts to a crying of somp. The doctor who uses such preparations cleats the patient and deceives himself, suless he uses them

as vehicles for suggestion in which case a pill or a capsule containing an

equally harmless but less expensive stuff will do as well

a few cubic centimeters of the extract are injected subcutaneously into an adult person. It has also been alleged that leukocytic extracts increase the immunity reaction, and aid the action of specific scrimis, antitoxin, and vaccines. There is no evidence for this

letion of Leukocytic Extracts.—The action of the extracts in infections is probably not specific. It is well known that the injection of any foreign protine in more cases a temporary fever and leukocytosis. To the extent that these two reactions are of value in infectious discases, leukocyto extracts other organ extracts or still better, simple proteins may have some effect. But this is drug action, not organotherapy.

The important role in immunity (phages tesis production of immune bedies) ascribed to the leukocytes by Metchinkoff is probably respon libe for the great attention given to leukocyte cytracts in infectious diseases. The leukocytes are not important elements in the fixation of antigens und production of immune bodies (Hektori and Cyrlson)

Hemoglobin Feeding —The feeding of hemoglobin in various anemies is not organitherapy. There is no evidence that giving hemoglobin by mouth or parenterally stimulates the bone marrow or prolongs the life of the crythrocytes except as this may be done by any other organic iron compound

Lymph gland Therapy—On the bisis of incompetent experiments (bemodinamic action following intrivinous injection of extracts of the jimph jainsly Marforn has postulated a hormone (himphogana, line) production by the lymph jainsly Merrorius many for entire literature on the subject Vincent concludes that there is not the slightest reason for hilesing that the lymph jainsly carry out any endocrine function?

#### SHMMAPA

There is at present no organotherapy of the blood of the individual blood constituents or of the lymph glands

### THE KIDNEY

The theory that the kidneys produce a physiologically important in ternal secretion, in addition to their exertiors function, proposed in Brown Sequard and d trasonal in 1813 live keen shown repatible to be without foundation (Bradford Sinier Vincent and Sheen Lirison; Bunker and Grabfield) but it still finds some adherents (Itakurs). It has been claimed that higation of the uriters does not produce the ame effects on the animal as extripation of the lathers and that the runoval of the greater part of the Judney substance accelerates intable in a part

Blood transfusion has also been tried, with no significant results, in various infections, with the idea of transfusing immune bodies and active phagocytes to the patient. It has been tried in hemophilia purpuia hemorrhagica etc. But the most extensive transfusion therapy so far developed is that of the various animas. Clinical and experimental experience appear to agree that blood transfusion stimulates temporarily the blood forming or, use of the patient or the recipient, even in cases of permicions anima, unless the cachexia approaches that of a moribinal condition. The transfusion is, therefore, of value as a timporary pal future measure, not so much in virtue of the quintity of normal blood transferred as in the fact that this blood returally stimulates the patient so win blood forming organs to greater activity. In cases where the anima appears to he due primarily to for rapid destruction of crythrocytes, we may expect blood transfusion to be of less benefit.

This sology and pathology give us no hasis for expecting, and clinical experience has not shows, that are mus, except that due to actual me channel loss of blood is cured by transfusion, especially where the condition is hereditary or partakes of the nature of malignance.

Therapeutic Uses of Leukocytic Extracts - Hiss and also Hiss and Zinsser, beginning in 1908, reported that intraperatoncal or subcutaneous injections of extracts of leukocytes in animals, and subcutaneous in rections of the extract in human patients, project against many infections (pneumococcus staphylococcus, streptococcus, meningococcus, typhoid, dysentery and cholera), and in patients hastens the recovery from these infections Zins er. McCoy and Chapin later reported a similar protective action of lenkocytic extract mainst experimental bubonic plague Flord and Lucas and also Lambert report good results from lenkocytic extracts in pneumonia and erssipelas. On the other hand, Manuder observed no favorable results in any infection. Williams and Youland stated recently that leukocytic extracts have no effect on the temperature, the loukocyte count, the condition of the patients, or the course of the dis case in lobar pnemnonia Youland obtained practically negative results with the extracts of experimentally induced, acute infectious in animals, thus contradicting the original observations of Hiss and Zinsser

Archibald and Moore report that injections of leukocytic extracts pioduce a temporary leukocytosis in normal animals and normal persons as well as in patients with infections diserses. They claim to liate obtained good results, and report one case each of lobar pneumonia, cellulitis, puerperal sepsis, empyrims, and ergapelas. The cases reported provenothing definite as to the value of the extract injections.

Archibald and Moore ascribe the favorable action of leukocytic extracts to the stimulation of leukocytous. Manewing supports the view of a direct bactericidal action of the extract. Such bactericidal retion can be demonstrated in titro but it is too slight to be of any significance when a few cubic continueters of the extract are injected subcutaneously into an adult person. It has also been alleged that leukovatic extracts increase the immunity reaction, and aid the action of specific serium, antitoxins, and vaccines. There is no evidence for this

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Lymph gland Therapy—On the basis of incompetent experiments (hemodynamic action following intrivenous injection of extracts of the lymph gland) Marforn has postulated a hormone (1 impho_anglino) production by the hymph glands. After reswaing the entire literature on the subject Vinenet concludes that there is not the slightest reason for believing that the lymph glands early out any endocrine function.

#### SHARARA

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#### THE KIDNEY

The theory that the kidness produce a physiologically important in transferencion, in addition to their evention function, proposed by Prom Sequard and d'Arons al in 15). has been shown repeat lik to be without foundation (Bradford, Suner Vincent and Sheen Karsiner Bunker and Grabfield) but it still finds some adherents (Italiana). It has been claimed that highton of the uniters does not produce the same effects on the animal as extirpation of the kidness and that the removal of the greater part of the kidness with the case accelerates included in apput

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### THERAPEUTIC USES OF OTHER ORGAN EXTRACTS 781

vanced by European eliminans Good results are reported of course Jauregg and Bayer (Lehrbuch der Organotherapie) listed fourtern organotherapeutic liver preparations on the market Eleven of these were 'made in Germany'!

There is at present no rational or useful organotherapy of the liver and because of the nature of the liver functions there is little or no hope for the future in this direction. But hochemical research may produce from the liver substances of hological and clinical importance in the way of drue actions.

The recent work of Mann and others on extripation of the liver indicates that the depression and death of the animal following loss of the liner is accompanied by extreme hypogheemia. The depression can be temporarily controlled by intravenous injection of glucose but the animal dies despite the glucose administration. The cause of this hypogheemia is not known. The condition is not improved by here extract administration. But Hooper has shown that feeding liver can partly control the digestive disturbance following the complete elimination of the bile from the digestive tract in dogs.

### THERAPEUTIC USES OF OTHER ORGAN EXTRACTS

Brain and Spinal Cord—The treatment of epilep v umentia, dementia praceo, mania, melancholia chorea titunus hidrophobia etc., mania, melancholia chorea titunus hidrophobia etc., with extracts of nerious tissue is, in the light of our present knowledge less rational than the principles and practices of Virs Edd. The litera ture on this therapy is abundant, contradictors and worthless. This is not saying that the nerious tissues produce or store no horizones or that interesting and neefful drugs may not be prepared from these tissues. But these things will near be evaluabled by indiscriminate feeding of dried brain to patients. I crhaps we would make gratter progress if the amanifactures could be induced to use the brains of horses instead of as es and sheep for their raw material and the finished product was taken by the doctor instead of circu to the patient.

Bone Marrow—The tid marrow of the lones is in e-ential factor in the production of red corpusels and probably in the formation of many influent bodies. But there is no evidence that feeding or injections of lone-marrow extracts is of any prietted value in bone-marrow diseases.

Tumors—Rational basis for the treatment of malignant growths with tumor extracts has been sought in the principles of vaccination and the "protective ferments of Abderhalden. The results are unrehable or negative (Schubert, Bauer Lotzel and Wissley) from or in the absence of uremia Noue of these claims has been substantiated

Italura has recently advanced the novel view that the kidneys regulate the concentration of the sugar in the blood by an internal secretion. This is unlikely, in view of the absence of primary renal involvement in diabetes, and the absence of hyperglycemia or reduced power to oxidize sugar in nephritis, excent as the to unrema

Practically all the therapentic uses of kidney extracts have been related to conditions of impairment of the exerctory functions of the kidney Capitain, Donovan, Formanck and Liselt, Renant and others have reported the cure of nephritis and uremia by feeding kidney or subcutaneous injections of kidney extracts. Others report negative or injurious effects (Lewandowsky, Senator) Kidney extracts have no specific di uretic action but kidney extracts for kidney organotherapy are on the market Jauregg and Baser listed (1914) seven German and one French eommercial preparations. And here is a sample of the American chinical evidence for the efficiency of dried kidney substance in nephritis "The woman was five months pregnant, the urme showed a low specific gravity, about 1 per cent albumin, and other indications of renal embarrassment She was given renal compound (dried Lidney and pancreas) use for two months together with a regulated diet and rest the urine shouled a normal specific gravity and no albumin I cannot help but feel that we owe a good deal to organotherapy" (Harrewer) 6

In the light of our present knowledge of Lidney functions and kidney pathology the treatment of uremia and nephritis by Lidney extracts is

useless and possibly injurious

### THE LIVER

The liver plays a very complex part in the animal economy, external secretion (bile), detoxication (ammonia, amino-acids, hemoglobin, poisons, etc.), internal secretion (£j\$co,cin, fibrino_en, antithrombin, immine bodies, etc.), desaturation of the fats, storige of vitamins, etc. So far as we know, all these processes depend from moment to moment on the living hepatic cells, and, as far as we know, there is stored up no substance of the nature of a hormone in the liver cells. Hence, there is no rational basis for liver organotherapy. Nevertheless extracts of the liver have been administered (by mouth or subcutancously) in cirrhosis, dia betes, Banti's disease, hemoptisms, purpura epistaxis, hematemesis, metrorrhagna, prurigo, urticarin, snake bite, and other affections! It appears that most of this irrational and certainly useless therapy has been ad

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Muscle — Vert is a good food for most people in health and for some people in discrse But meat extracts are of no value as organotherapeutic agents

Lung Parotid Gland, Tonsils Lymph Glands, Retina, Iris Nasal Mucous Membrane, Ete—Why complete the list? I mig, parotid gland, tonsils, lymph glands, retina, 1175, naval mucous membrane, etc, have been used, in modern medicine to cure discusses of these tissues. We are fraud this chapter firmishes an argument against evolution in medicine. It would be rare himor—if we were not dealing with himman ills, and with a profession standing for intelligence and honesty, in opposition to the quacks.

#### SHMMAPA

The sum total of established facts after thirty years of clinical and experimental work in organishmaps are few and quickly stated

But a treatise on the general principles of organotheripy miolics to day, in a large measure, the disagreeable and thankless task of clearing way worths and misleading rubbist. We believe that the reader who has had the interest and diligence to follow us through this chapter will agree to this proposition, and we have endeavored to do it on the basis of climical and experimental facts and blook_rell reasoning.

In the greater task of pointing out new lines of possible advance and control, we have endeavored to steer a middle course between the Scylla of therapeutic nihilism, and the Charybdis of therapeutic credulity

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